UNIVERSITY OF EDINBURGH

GRASS AND GRASSLAND PRODUCTS AS THE SOLE DIET OF HILL SHEEP

SUB-TITLE: The Influence of Methods of Wintering Blackface Ewe Hoggs on their Growth, Health and Lifetime Productivity.

by

THOMAS HOWARD JACKSON
B.Sc. (Hons. Agric.), Dunelm.
M.S., North Carolina.

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Department of Agriculture.

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TABLE OF CONTENTS

The/

TABLE OF CONTENTS (Continued)

LIST OF TABLES

Table XV./

LIST OF TABLES (continued)

Table XXXI./

LIST OF TABLES (Continued)

Table XLVII /

LIST OF TABLES (Continued)

LIST OF APPENDIX TABLES

Table 9/

LIST OF APPENDIX TABLES (Continued)

Table 16(a)/

LIST OF APPENDIX TABLES (Continued)

Table 24(a)/

LIST OF APPENDIX TABLES (Continued)

Table 33(a)/

LIST OF APPENDIX TABLES (Continued)

Table 41/

LIST OF APPENDIX TABLES (Continued)

Table 47(a)/

LIST OF APPENDIX TABLES (Continued)

Table 55(a)/

LIST OF APPENDIX TABLES (Continued)

Table 64/

LIST OF APPENDIX TABLES (Continued)

Table 71/

LIST OF APPENDIX TABLES (Continued)

INTRODUCTION

Although comprehensively interwoven, the sheep industry of Great Britain is categorised into three production areas. On the hill country or regions of poor grazing, self-maintaining, pure-breeding flocks of small hardy sheep are run. The more favourable lands at the foot of the hills, usually termed marginal lands, are stocked with the surplus drafted ewes from the hill flocks and are cross-bred with an "improver" breed to give progeny that are larger and more prolific than the hill breed. The females of this cross are valued as excellent breeding stock for intensive fat lamb production on fertile lowground farms. These sheep are generally crossed with a "Down" breed of ram, which produces the desired end-product of choice fat lamb. Theoretically these lambs contain half Down breed blood, quarter "improver" breed blood and quarter hill breed blood.

The pure-bred hill flocks are important in the economy of the British sheep industry because they provide the foundation breeding material on which the rest of the industry is built. For this reason factors which affect the standard of the hill flocks may have an influence throughout the industry.

The hill flocks are generally run in regular age groups; that is each year a number of ewe lambs are reared for replacement into the flock, while ewes that have produced four or five crops of lambs are drafted out to the marginal farms. The flock is made up from an approximately equal number of ewes having four, three, two and one crops of lambs.

A feature of this organisation is that the ewe lambs selected for replacements are not bred from in the first year, but are allowed to mature and are served to lamb down at two years of age. The period from their selection at weaning time, five months of age, to tupping time, nineteen months of age, is known as the "hogg" stage.

This/

This hogg stage is a critical one in the ewe's life. It is a period of development, not only of bone, muscle and body reserves, but also of internal body organs. On weaning, in September, the ewe lamb faces a six months' winter period when nutrition on the hill grazings is at its lowest. In practice two widely differing views are held as to the best method of treatment for the hoggs through their first winter, bearing in mind that the ewes have to live on the hill and produce lambs and wool each year for four or five years without additional feeding. The hoggs can either be kept on the hill or removed to better wintering pastures. The traditional practice of away wintering the hoggs on lowland farms is being questioned on grounds of economy and soundness. The advocates of retaining the hoggs on the hill during the winter claim that the lamb gets to know the ground on which it is to spend the rest of its life - finding areas of early growth, shelter and better nutrition. Also the hogg only grows to the size the ground can support, and again a severe test during the first winter ensures that the hogg is suited to that particular environment (selection). The advocates of removing the hoggs from the hill and putting them on to good lowground pastures claim firstly, to be able to keep more ewes on the hill during the winter time, secondly, that the hoggs are well grown and well fleeced on return to the hill at the end of the winter and also that they have greater body reserves and better developed organs to withstand the rigours of the following winters. Criticism is that the hoggs may have grown too big for the ground, too much food having to go to maintenance and not enough for production. Finally, it is argued that the good lowground wintering will have masked any unsuitability of the hoggs to thrive under sparse hill conditions. This would put greater stress on selection as ewes.

It/

It is realised that each hill farm differs in factors of environment and management and that these weigh heavily in considering the suitable method of wintering for the hoggs. In the following trials, only one hill farm was used and the trial repeated in only two years. Despite the above limitations, it is hoped that the trial will be of value in indicating the relative merits of four wintering practices for ewe hoggs on a particular hill farm by measuring the physiological responses to the treatments.

To make general recommendations concerning the effect of hogg wintering practical on subsequent production would require the study to be continued over several years and at several locations. These more comprehensive facilities are available to the recently formed Hill Farming Research Organisation.

REVIEW OF LITERATURE

Although the keeping of sheep is one of the oldest occupations known to man, there is still much investigation required before the complexities of their growth and development and the relation of these processes to production are fully understood.

History of the Blackface Breed

There seems little doubt that the Scottish Blackface breed was developed from the dark faced hill sheep, horned in both sexes, growing good quality mutton and rough carpet wool, that had for centuries been found on the high heather-covered hills of Northern England and Southern Scotland. Fraser (1957) indicated that in the course of centuries this native breed had become split into a variety of related breeds - the Lonk, the Swaledale, the Rough Fell, the Scottish Blackface. Of these the most numerous was the Scottish Blackface and in the late eighteenth and early nineteenth centuries it extended from the border area, which was most probably its area of development, as a distinct breed, being known then as the "short" sheep (for its compact nature) and also the "Linton" sheep (because of its main area of sale), to the Highlands when the clearances of clansmen from that area took place.

From this time on, the breed formed a solid foundation for the hill sheep industry of Scotland. At first the Highlands were stocked entirely by wether sheep, wether lambs being bought in South Scotland for droving north. With gaining confidence ewes were brought to the better grazings of the lower elevations, while the high hills remained under wether stocks. With the advent of meat refrigeration, the value of mature hill wethers fell progressively until they were dispersed. The high hills succumbed to deer, while the lower hills were forced to carry ewe stocks without wethers making thereby

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a demand upon fertility often beyond the natural resources of the ground. The main article of sale became the wether lamb and the breed was changed towards earlier maturity to make wether lambs more saleable.

Traditional System of Hill Sheep Management

On hill farms which rely on production from the unimproved native herbage a system of flock management has evolved to fit closely into the seasonal production.

As the herbage is late to grow in spring due to the nature of the grasses and also to the elevation and exposure of the ground, the ewes are planned to be lambed a few weeks before the expected flush of grass in early to mid-May. In the area where this study was made, lambing commenced on the third week in April. Other dates in the shepherd's calendar are timed from this expected flush of grass. The castration of the lambs and the shearing of the hoggs coincide at mid-June, while the shearing of the ewes takes place a month later. Weaning of the lambs takes place in early September in order to allow the ewes to gain in body weight before tupping in December and the onset of pregnancy during the severity of the winter.

Four or five crops of lambs are taken from each ewe which produces its first lamb at two years of age. Ewe lambs are selected in the October of each year for replacements. At the same time the older ewes are drafted.

Traditional Methods of Treatment of Ewe Lambs from Weaning until First Pregnancy

The period from weaning in October to first pregnancy over a year later is one which is traditionally utilised for growth and development to equip the animal for the strain of subsequent production. The period falls naturally into two parts. The first part from weaning (October) until the following/

following spring (April) is one of low nutritional resources on the hill. The second part (from April to first mating) coincides with a nutritional surplus on the hill and the hoggs are able to grow and develop adequately on the hill herbage throughout this period. It is the first part from October to April, or the "hogg wintering" period as it is called, that presents the problem.

Traditional Hogg Wintering Practices of Scottish Hill Sheep

Although no official survey has been reported on hogg wintering practices, the literature does indicate that the practices vary.

The Hill Farming Research Organisation's first report (1959) showed that at Glensaugh (Kincardineshire) the traditional practice of that area was to away winter the hoggs, but each year after 1944 more and more hoggs were wintered at home on improved "inbye" fields until 1956 when all hoggs were wintered at home. They also reported that at Lephinmore (Argyll) the ewe hoggs were wintered away because of the lack of inbye fields, while at Sourhope (Roxburghshire), following local practice, the hoggs were kept on the hill throughout the winter.

Noble (1958) confirmed the practice of away wintering the ewe hoggs in Argyll and suggested that the primary reason was that if the hoggs were kept at home, they would compete very seriously for the black ground which is below the snow level in a storm, having the effect of necessitating a reduction in the ewe stock. Doubt was expressed as to whether or not home wintering (on the hill) would make the hoggs grow well enough to make as good sheep as away wintering.

Stewart (1959), also farming in the Argyll area, suggested that current costs for away wintering of ewe hoggs were too high for the poorer Highland sheep/

sheep farmer. On the other hand he also pointed out that cheap wintering resulted in smaller gimmers and led to increased losses. As an alternative an attempt was being made to winter ewe hoggs indoors.

Campbell (1956) stated that in the Inverness area the customary practice of wintering hoggs away from the hill ground was becoming one of the hill sheep farmer's costliest items. He suggested that it was inadvisable to winter hoggs on low ground on turnips because this affected the quality of the animals a year later in many ways. It upset them when they normally changed from milk to permanent teeth and they were unable to cope for their first month on the hill in April as hoggs. He not only pointed out that the cost of the wintering was increasing, but also that the transport cost to and from the place of wintering was increasing. Campbell cited the northern and western districts of Scotland as places where the kindly influence of the Gulf Stream made home wintering practicable.

Steel (1958) stated that on his hill farm in the Upper Ward of Lanarkshire the stock ewe hoggs were wintered on the hill. The ewes never had access to inbye fields nor had they been hayed in winter, yet the lamb crop was 100 per cent. This compared with 75 per cent reported by Noble in Argyll.

Coutts (1955) suggested that the South Country sheep farmers had, on most of their hills, wintered their hoggs at home, but on the more barren mountains of the North-West and Central Highlands a home wintered hogg was a sorry object. The farmer who had some arable, it was indicated, could by reseeding manage to winter some hoggs at home away from the hill. However, a hill farm's carrying capacity was the number of sheep that it could carry in the worst months of early spring and if times came when wintering hoggs away from the hill could not be accomplished, either because winterings could not be found or because it became uneconomic to do so, then sheep farmers would be forced, in certain districts/

districts, to winter hoggs at home on the hill, which would necessitate reducing the ewe stocks.

From the foregoing reports practical experience seemed to indicate that the wintering of the hoggs at home on the native hill was a practice which could be successfully used only on the better hill land. On the poorer farms alternative methods must be found. However, the opinions cited were of a general nature with no controlled experimental evidence to support them.

Three alternative methods to hill wintering were suggested. Firstly, away wintering on good lowground pasture; secondly, off-the-hill home wintering on improved inbye fields; and thirdly, indoor wintering.

The Effect of Different Hogg Wintering Treatments on Hill Sheep

At the commencement of the trial no direct evidence was available concerning the influence of different levels of nutrition during the hogg wintering period on the subsequent performance as ewes. Since the trial commenced, certain investigations have been reported which were complementary to this study.

Traditional practices of wintering ewe hoggs reflect the nature of the hill farm, the relationship with economic factors as well as the personal philosophy of the farmer.

Doney (1955) suggested that a breeding objective for hill sheep must embrace the output of draft breeding ewes, store lambs, and, to a lesser degree, wool, as these formed the major source of commercial hill sheep farming. Since these commodities are produced under rigorous hill conditions, the complex characteristic of hardiness must also be involved. Interpreting these commodities into objective criteria, the ewes must possess large size and condition, fertility, milkiness and longevity for optimum production both

on/

on and off the hill. Management practices which affect these criteria, either directly or indirectly by masking them so that selection for that trait is weakened, must be examined carefully.

Body Weight Responses

Few studies have been reported on the live weight response of hoggs to different wintering treatments.

Smith, R.G.C., (1953) reported on observations that had been made on the response of hoggs from Glensaugh to two different wintering regimes. The hoggs were split at random and one group was away wintered, while the other remained at home on "inbye" fields. In general, in the good winters of 1947-48, 1948-49, when both home (inbye) and away wintered groups gained weight, the latter gained rather more than the former, but in the bad winter of 1946-47 the latter suffered the greater loss. The best gain in weight for the home (inbye) wintered hoggs was in the first year of the experiment, 1944-45, when the hoggs averaged 21 pounds live weight gain. The next best gain for the inbye wintered group of hoggs was 15 pounds in 1948-49. In this same year the away wintered group of hoggs gained 19½ pounds in live weight.

Smith also pointed out that the difference in body weight between the two groups at the end of the wintering period (1st April) tended to diminish by the following autumn and subsequently with age. He suggested that the latter was likely because the "poorer doing" ewes of less weight in all groups were eliminated annually, either by death or by culling. However, in general, the heavier group at one and a half years of age remained so for the rest of the records (four years).

Davies (1954) working at Bangor, North Wales, with the Welsh Mountain breed, reported on trials conducted over three years to study the variation in/

in live weight response of hoggs wintered at different centres. He reported wide differences in the gain of hoggs between lowground centres within any one year (+1.4 to +15.2 pounds in 1948-49; -2.8 to +14.2 pounds in 1949-50; +2.5 to +8.3 pounds in 1950-51). Between years at the same centre variation was also large, being for the three years 1948-50, 15.2 pounds, 6.7 pounds and 8.3 pounds at Centre 2; 8.4 pounds, 7.4 pounds and 7.2 pounds at Centre 3; 12.6 pounds, 8.3 pounds and 2.5 pounds at Centre 4.

In the year 1950-51 home wintering on the hill produced a loss of 5.3 pounds. This compared with a loss of 2.8 pounds in 1949-50 and a gain of 1.4 pounds in 1948-49 at Centre 1 (the poorest away wintering centre).

Concerning the gain during the following summer, Davies reported that the poorer the performance during winter, the higher the live weight gain on the hill during summer. However, despite this accelerated gain, the poorer wintered hoggs were still put to the ram lighter than the better wintered groups.

The Effect of Wintering Quality on the Productivity of Hill Sheep

Fertility. Philips et al. (1945) working with range sheep at Utah showed that differences in wintering regimes as hoggs could affect the numbers of lambs born in the first production year. They suggested that the reason for this was a greater development of the reproductive tract in well wintered animals than in those that were poorly wintered.

Davies (1954) observed that the number of ewes which were barren in relation to the number that were tupped in the first production year was much greater for the poorly wintered groups of hoggs.

Smith (1953) reported that there were no significant differences in percentage of barren ewes in the first production year between the hoggs which were home and those which were away wintered. However, only small differences

were/

were reported between live weight responses to the wintering of the two groups and the groups in all years made substantial gains.

Birth Weight. Davies (1954) showed that in the Welsh trials no between-centre differences in birth weight existed. Smith (1953) disregarding wintering practice and using as an indicator of good or bad wintering the live weight at the end of the first winter, showed that the average birth weight of lambs in the following year was higher in the groups that were heavier at the end of the first winter. This, however, may only have reflected that the larger ewes had larger lambs.

Weight of Lamb Produced and Longevity. No information appeared in the literature concerning the weight of lamb weaned from ewes having undergone different hogg wintering treatments, nor were there any data on the effect of such treatments on length of life or persistency of performance.

Wool Clip. Davies (1954) showed that in the first shearing year the hoggs that were wintered badly clipped 15.8 ounces less wool than those hoggs which were wintered at the best centre. However, in subsequent shearings no differences were detected. Smith (1953) stated that the hoggs which were wintered at home - on a slightly lower level - had been found to have lighter and finer fleeces than those of hoggs wintered away.

It would appear that severe restriction on growth throughout the hogg wintering period did influence production, in the first production year at least, by lowering the weight of wool clip and by increasing the incidence of barrenness.

Concept of Growth and Development

Callow (1947) working with cattle, McMeekan (1941) working with swine, Wallace (1948), Hammond (1932) and Paalson and Verges (1952) working with sheep/

sheep, have shown how the proportions of the tissues of animals alter during growth, development and fattening. It has been demonstrated that over all the body, growth is not proportional, but rather a series of growth waves appears to spread from the anterior to the extremities. It has also been shown that tissues develop differentially, bone being the earliest and fat the latest developing, while within each type of tissue some areas develop before others, e.g. cannon bone before tibia.

As more is discovered concerning the factors which influence the continuous process known as growth and development, the better will the consequences of practices which are imposed on livestock be appreciated. Modern physiological genetics and embryological research, reviewed by Wagner and Mitchell (1955), shows the fine interrelationships between developing components. Development may be divided into differentiation, organisation and growth. In the developing organism differentiation is accompanied by organisation or localisation of differentiated cells leading to morphogenesis. This is usually accompanied by growth, a process defined here as an increase in mass of protoplasm with or without increase in number of cells.

If the action of genes (heredity factors) is considered in the light of the three principal aspects of development that have been designated, it becomes evident that genes have a number of functions. They must control differentiation, for the types of cells and tissues produced are different for each type of organism; they must control the organisation of parts too, for form and structure are inherited; they must also control growth, for it is not considered an uncontrolled process because organisms have various sizes and shapes and their organs and parts have regulated sizes too.

From work with tissue cultures it has been shown (Spratt, N., 1950) that tissues differ in their nutritional requirements, both qualitatively and quantitatively/

quantitatively, which indicates basic metabolic differences among tissues. It has also been suggested that, because embryonic tissue responded in the same way as the adult tissue to nutritive sources and inhibitors, the metabolic pattern of the early differentiating tissue is similar to the metabolic pattern necessary for its maintenance in the adult.

The differences in synthetic capacity expected as a result of changed metabolism of differentiated cells is manifest in form, chemical constitution, physiological response, secretory ability, etc. Although certain differences in content among cells may be ascribed to some absorbing and storing compounds synthesised by all, it is obvious that many are unique sources of certain compounds. This feature is illustrated in the endocrine function of higher organisms and in antigenic differences.

Growth and development is a complex system of tissue interrelationships controlled initially by the genotype and later influenced quantitatively and qualitatively by the metabolic processes occurring in differentiated tissues. The rate of production of body substances in growing animals depends on the stimulus for growth and on the level of available food nutrients.

Studies Concerning the Physiological Effects of Nutrition during Rearing

The lowering of the level of feeding of growing cattle and sheep has been shown to retard growth as measured by daily live weight gain and skeletal development. Late maturing parts of the body are affected most and early maturing parts least (Moulton, Trowbridge and Haigh, 1921; Lush et al., 1930; Hammond, 1950; Bonnier and Hansson, 1946 and 1948; Crichton, Aitken and Boyne, 1959). Although Eckles (1946) and Joubert (1954) have demonstrated that differences in body size between animals reared on different planes of nutrition/

nutrition may still be evident at four or five years of age, Moulton, Trowbridge and Haigh (1921) found no difference in height at withers between "high" and "low" plane animals at four years of age. King (1953) also showed complete recovery of cattle when the planes of nutrition were not extreme. Permanent stunting may occur on underfed animals (Hogan, 1929) and full recovery is less likely if underfeeding is combined with early pregnancy (Eckles, 1946).

Concerning milk yield, Eckles (1946), Hansen and Steenberg (1950), and Reid (1953), all working with cattle, showed only small differences in milk yield during first and second lactations between cows which had been poorly fed and those well fed during rearing. In the study reported by Joubert (1954) on the effect of underfeeding caused by winter droughts under natural grazing conditions in South Africa four breeds were used. He reported that the milk yields of unsupplemented, intrinsically high-yielding Friesian and Jersey heifers were not affected by the plane of nutrition during rearing when feeding during lactation had been according to milk yield. The underfed animals showed greater persistency of lactation. However, Joubert (1954) found that the beef breeds studied responded differently to the dairy breeds. The growth of the calf served as a criterion of milking capacity for the beef breeds and during suckling the cows continued to lose weight until the tenth month after calving, whereas the dairy heifers grew steadily throughout lactation. The high plane beef heifers showed relatively greater losses during lactation due, probably, to higher milk yields. However, it was the low plane heifers which grew the fastest in the dairy breeds. The low plane beef heifers showed lower weaning weights of their calves compared with those of the high plane group. Although the calves from the low plane dairy heifers were lighter at birth than their counterparts, no prenatal influence could/

could be observed on growth and development when both groups were treated the same to twelve months of age.

Crichton, Aitken and Boyne (1959), working with dairy cattle, demonstrated the effect not only of high and low planes of nutrition during rearing, but also alternating high and low planes. All groups reached sexual maturity at the same stage of physical development, but at different ages. The high-low animals were the slowest to attain maturity, indicating that as with growth, the changeover from a high to a low plane of nutrition had had an adverse effect. Low plane animals on poor hill pasture made better growth than their mates on good arable pasture, although part of this growth was shown to be due to increased "fill".

Zimmerman et al. (1959) reported that in beef heifers calving at two years of age and reared on low, medium and high planes of supplemented winter feed, birth weights were reduced in the low level lots. The high level supplementation resulted in slightly heavier calves at weaning.

Hansson (1956) reported on studies made with one-egg, twin dairy cows reared at 60, 80, 120 and 140 percentage of the standard level of nutrition. After twenty-five months of age, the experimental twins received exactly the same level of nutrition as their corresponding control twins. Within these wide limits of variation in the level of nutrition the young animals continued to grow, but they did so at different rates and they reached practically the same final body development at maturity. The intensity of rearing thus primarily influenced the rate of growth, which implies that animals on a high level of nutrition reach the mature stage at an earlier age than animals on a lower level of nutrition. Consequently it was shown that longevity was also affected by nutrition. It was seen that the flexibility of the rate of growth decreased as the animals grew older, suggesting that it was in the young animal that/

that the growth rate could be influenced most. The experiment indicated that the highest milk yield was obtained when the heifers were reared on a low level of nutrition up to two to three months before calving and then on an increased level up to calving. This effect of rearing intensity on milk production tended to increase from the first to the following lactations.

Discussing longevity, Hansson (1956) showed that in earlier experiments when dairy heifers had been reared on a low plane, the average length of life was ninety-five months as compared with seventy-five months for those animals reared on a high plane. Discarding was only done for failure to conceive and disease, but part of the difference may have been caused by the increased stress on the organism which followed increased feeding. Both rate of breathing and heart beat increased as the level of nutrition was raised. Heredity and age also had a significant influence on these rates.

EXPERIMENTAL PROCEDURE

This research embraces two main issues. Firstly, an attempt is made to record the growth, development and production of ewes of the Scottish Blackface breed, kept throughout their productive lives on a natural hill pasture without any additional artificial feeding. Secondly, variations in planes of nutrition during the rearing period of their lives (from 6 - 12 months of age, called the hogg wintering period) are related to subsequent performance as ewes in order to determine the effect of these designed and naturally occurring variations in nutritional level during rearing on their health, growth, skeletal growth and productivity.

The trials were laid down over two years, the first commencing in October, 1952 and the second one in October, 1953. Data were collected at times most suitable to the normal handling of the flock. The usual practice of drafting the ewes after four crops of lambs was adhered to, making the period of observation for the first trial from October, 1952 to September, 1957 and the second trial from October, 1953 to September, 1958.

Material

Ewe hoggs of the Castlelaw flock of pure bred Scottish Blackfaces were used. Up to 1952 no detailed records were kept, but no intensive selection had been practised and rams were bought in from a wide range of commercial flocks to maintain the stock.

Four naturally occurring breeding units (hefts) were present, which due to natural boundaries maintained relative isolation on areas having specific vegetation and exposure differences.

Boghall heft has a northerly aspect and is predominantly heather ground. The land is steep with very little downfall.

Howgate/

Howgate heft has an easterly exposure and is balanced between heather and white ground (Nardus-Agrostis). There is very little depth of soil and the area suffers readily in drought.

Front heft is predominantly white ground (Fescue-Agrostis) which has access to heather. With a southerly aspect it is exposed to the prevailing south-westerly, and also the easterly wind which blows in spring. There are substantial areas which have a reasonable depth of soil and certain areas have been treated with lime and slag which encouraged clover development.

West Park has a south-westerly exposure and is mainly unimproved white ground (Nardus) overlying a wet, peaty subsoil. The sheep have access to heather on the higher ground.

The deeper soil of the Front and West Park hefts has carried a small Galloway herd as well as the sheep stocking.

Method

In the 1952 trial one hundred and twelve ewe lambs were selected for replacement into the flock. These were taken equally from the four hefts. Each lot of twenty-eight from each heft was split at random into four treatment groups. Each of these subgroups was allocated at random to one of the treatments, giving a randomised block design with hefts x treatment factors containing seven animals.

Composition/

Composition of 1952 Trial

Heft	Treatment				Heft Total
	A	B	C	D	
Boghall	7	7	7	7	28
Howgate	7	7	7	7	28
Front	7	7	7	7	28
West Park	7	7	7	7	28
Tmt. Total	28	28	28	28	112

In the 1953 trial a similar design was used, but as only ninety-six ewe lambs were kept for replacements, making twenty-four from each heft, the treatment group on each heft contained only six animals.

Composition of 1953 Trial

Heft	Treatment				Heft Total
	A	B	C	D	
Boghall	6	6	6	6	24
Howgate	6	6	6	6	24
Front	6	6	6	6	24
West Park	6	6	6	6	24
Tmt. Total	24	24	24	24	96

Treatments

The treatments were applied over the first winter of the ewe lamb's life. The treatments coincided with natural practices and lasted from approximately 1st October (six months of age) to 1st April (twelve months of/

of age). After this treatment period, all the animals remained on the hill on their particular heft, the ewes of each heft being mated to the same sire.

Treatment A was regarded as the negative control. It consisted of allowing the hoggs to remain on the hill for the whole of the wintering period. The lamb was weaned from its mother by holding the lamb in an enclosure for a ten day period before returning to the hill. This treatment is referred to as "hill wintering".

Treatment B was regarded as the positive control. The hoggs on this treatment were sent away to a good lowground dairy farm, which had no sheep stocking of its own, on 1st October and returned to the hill after the wintering period on 1st April. This treatment is referred to as "away wintering".

Treatment C was similar to Treatment B and was used as an alternative positive control. The hoggs were kept on an improved inbye field of the hill farm throughout the wintering period. They returned to the hill on 1st April. This is referred to as "inbye wintering".

Treatment D was peculiar in that it was a combination of Treatments C and A. From 1st October until 1st January the hoggs were kept on the same inbye field as Treatment C and then on 1st January they were returned to the hill to spend the rest of the wintering period similar to Group A. This is referred to as "inbye ½ wintering". Treatment D was included to test whether the whole of the positive wintering treatment was necessary. In the 1953 trial this treatment was altered so that the first part of the wintering period (1st October - 1st January) was spent on the same treatment as Group B and then returned to the hill. This is referred to as "away ½ wintering" treatment.

The dates stated are only approximate and the exact dates of the changes coincide with the dates when observations were made. These are accurately stated/

stated in the text, but as they did vary within narrow limits from year to year, the dates of the shepherd's calendar were taken to represent them.

Statistical method is from Snedecor (1956). The analysis of variance is of the form as illustrated:-

Analysis of Variance

Source	d.f.	s.s.	m.s.	F.
Total	t*			
Between Total Tmts.	15			
Winterings	3			
Hefts	3			
Hefts x Winterings	9			
Within Tmts.	(t-15)			

* t = total number of observations -1.

The mean square hefts x winterings was used to test for treatment and heft differences and the within treatments mean square used to test for wintering x heft interaction. This form was used up to production time. Unfortunately after this period, missing data prevented this analysis from being effective, so the analysis for completely randomised plots was used to test for treatment differences.

Observations

Body Weight

Body weight measurements were taken at three-monthly intervals for the first year and annually in October for the remaining four years. Weighing was done randomly over each heft to overcome any bias that may have occurred due to time of weighing. Body weights were taken to the nearest half pound, but/

but subsequently converted to the nearest pound by adding half a pound to an odd last digit and subtracting half a pound from an even last digit. No adjustment in body weight was found to be necessary for ewes having reared twins during the season even though the ewes rearing twin lambs were treated differently to those rearing singles. (Ewes with twins were given access to an inbye field from lambing time till mid-July). Adjustment was made for ewes which were barren. The adjustment was made by taking a sum equal to that difference between the mean of the weight of the ewes which had reared singles and the mean weight of the group that were barren, and subtracting this sum from each of the barren ewe weights concerned.

Fleece Weights

In the first year the fleeces were weighed to the nearest ounce, but subsequently they were weighed to the nearest half pound. Clipping was done by hand shears by several trained operators who had the ewes assigned to them at random. The hogg clipping was in mid-June, while the ewe clipping was in mid-July. No adjustment was made for those ewes which were barren.

Skeletal Measures

Two bones were measured in the 1952 trial.

(i) The Cannon Bone was taken as an example of an early developing bone. The hind cannon was used (the measure to the nearest millimetre being taken as the mean of the two hind cannons) and the procedure was to bend the leg so that the ends of the cannon were accessible. Engineering calipers were used.

(ii) The Pelvic Bone was taken as an indicator of a later developing bone. The measure (to the nearest millimetre and the mean of the two sides) was taken by placing the ends of calipers, one end on the characteristic projection on the hook bone and the other end on the tip of the pin bone.

Owing/

Owing to the delay in animals returning to the hill as a result of taking these measures it was not possible to record the 1953 trial group as well.

Lamb Birth Weights

These were recorded within twenty-four hours of birth. For lambing the ewes were brought "inbye" and after lambing and recording, the ewes rearing singles returned to the hill, while the ewes rearing twins were kept on an inbye field until mid-July. Lamb weights were taken by using a portable spring balance to the nearest half pound. The lamb was then ear-tagged and recorded, associating it with its mother. Date of birth, type of birth and the sex of the lamb were also recorded at this time.

Weight at Weaning

The lambs were weighed at weaning in August. The weight was taken to the nearest half pound using an Avery 5 cwt. weighing crate. The weight at birth was subtracted from the weight at weaning and this was then divided by the days from birth to weaning to give the live weight increase per day over this period.

Adjustment

All the lamb weights were adjusted for type of birth and for sex within any one year. The difference between the mean of the group to be adjusted and the mean of the lambs born as single males in any one year was added to or subtracted from the original observation of the lambs for that group.

Example: If the mean birth weight of the single male lambs born in 1954 was 10 pounds and the mean of the twin male lambs born in 1954 was 6.0 pounds, then the adjustment factor for this group would be +4.0 pounds.

For any individual male lamb born a twin in 1954 the/

the adjusted observation would be:-

original birth weight +4 pounds.

For lamb birth weight, the assessment given to each ewe in the case of twins was the mean of the two adjusted observations. For lamb daily rate of gain to weaning, in the case of twins, both observations were used in the analysis.

RESULTS

In the analysis of this experiment some sets of comparisons were made which were nonorthogonal. Snedecor (1956) states that "this must not be considered a fault if the experiment accomplishes its purpose. The sum of squares for the set of comparisons will not equal that between means of groups and statements about probability may not be exact, but the comparisons are not lacking in interest".

An analysis of variance was conducted on all criteria and the treatment sum of squares broken down so that individual comparisons could be made and tested for significance. Only the comparisons approaching or attaining significance are shown at the foot of each analysis of variance table in the Appendix.

1952 Trial

Growth Responses to the Hogg Wintering Treatments

1. Liveweight

(a) Body Weight Changes during the Treatment Period. Treatment means for all the live weight observations taken are given in Appendix Table 1. As the relevant information comes under discussion, wherever possible the means will be extracted and presented in the text showing the heft differences also.

Table I gives the live weight (pounds) of the hoggs at the start of the wintering treatments, October 1, 1952, approximately 5½ months of age.

Table/

Table I. The mean live weight (lb.) on Oct. 1, 1952 of the groups and subgroups of Blackface hoggs randomly assigned from each heft to four different wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	67.7	65.7	66.0	64.7	66.0
Howgate	65.0	66.7	66.3	67.6	66.4
Front	72.3	67.7	70.0	70.1	70.2
West Park	74.0	72.3	72.1	74.1	73.1
Tmt. Means	69.7	68.1	68.6	69.3	68.9

The individual body weights of the hoggs and the analysis of variance are given in Appendix Tables 2 and 2(a) which show that when the hoggs of each heft were split at random into the treatment groups, there were only negligible differences in body weight between each group, but there were noted significant differences between the mean body weights of hoggs from each heft. Hoggs weaned from the West Park heft were on average 7 pounds heavier and hoggs from the Front heft 4 pounds heavier than those from the Boghall and Howgate hefts. Between the hefts and winterings subgroups there were differences in mean initial body weight as large as 9.4 pounds.

The table of individual body weights shows a range of body weights from 52 to 93 pounds.

Table II shows the average body weight of the hoggs of the treatment groups and subgroups at the conclusion of the first half of the wintering treatments in January.

Table/

Table II. The mean live body weight (lb.) on Jan. 6, 1953 of the groups and subgroups of Blackface hoggs receiving four different wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	63.6	70.0	73.3	68.6	68.8
Howgate	58.8	71.9	70.1	75.0	69.0
Front	65.0	71.6	70.3	75.0	70.5
West Park	65.7	73.4	77.4	77.7	73.6
Tmt. Means	63.3	71.7	72.8	74.1	70.5

The individual body weights of the hoggs and the analysis of variance are given in Appendix Tables 3 and 3(a). The analysis of variance indicated that there were significant differences between the mean body weights of the treatment groups, although not for the means of the hoggs from each heft. On testing these differences the hill wintered group of hoggs were significantly lighter ($P<.01$) than the other three groups tested together.

Although the overall test for heft differences did not reach significance, the comparison between Boghall and Howgate hefts with Front and West Park hefts did show that the hoggs of the former hefts were significantly lighter ($P<.05$) than those of the latter. There appeared to be no interaction between the hefts and the wintering treatments.

The treatment means indicate that over this period the hill wintered group lost on average 6.4 pounds body weight, while the away, inbye and inbye ½ wintered groups gained 3.6, 4.4 and 4.8 pounds respectively.

Over all the treatments, on average, the hoggs from Boghall heft gained 2.8 pounds, Howgate heft 2.6 pounds, Front 0.3 pounds and West Park 0.5 pounds.

Table/

Table III shows the body weight of the hoggs on April 1, 1953, after the wintering treatments were completed and before all the groups were returned to the hill environment on which they remained for the rest of their productive lives.

Table III. The mean body weight (lb.) on April 1, 1953 of the groups and subgroups of Blackface hoggs at the end of four different hogg wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	61.3	82.4	70.3	61.3	68.8
Howgate	58.7	85.9	66.0	67.7	69.6
Front	68.4	81.1	66.7	66.0	70.6
West Park	62.1	89.3	73.0	65.3	72.4
Tmt. Means	62.6	84.7	69.0	65.1	70.4

The individual body weights and the analysis of variance are given in Appendix Tables 4 and 4(a). The analysis indicated significant differences due to treatments, but no significant heft differences or heft x treatment interaction. On comparing the treatment means, the hill wintered group of hoggs were significantly lighter than the away wintered group ($P < .01$), the inbye wintered group ($P < .05$) and the three groups together ($P < .01$). The away wintered group of hoggs were significantly heavier ($P < .01$) than the other three groups taken both together and separately.

The treatment means indicate that over the period from January to April the hill wintered group of hoggs lost 0.7 pounds, the inbye group lost 3.8 pounds and the inbye ½ group lost 9.0 pounds, while the away wintered group gained 13 pounds. Over the whole wintering period (October - April) the hill wintered/

wintered group of hoggs lost on average 7.1 pounds and the inbye ½ 4.2 pounds, while the away wintered group of hoggs gained on average 16.6 pounds and the inbye group 0.4 pounds.

Over the period from January to April the overall mean weight of the hoggs remained the same, as did the mean weight of the groups of hoggs from each heft. There was no noticeable heft x wintering interaction.

(b) Body Weight Changes from the Wintering Treatments to First Mating.

The period from April to October (12 to 18 months of age) of the second year of the hogg's life is still a period of growth and development. The period following the first winter and before the first production winter is one of comparatively high nutritional level on the hill and the period allows recovery from the first winter and also physical preparation for the second.

In this study the period has been split into two sections - the first up to the hogg clipping date, June 22, and the second to the ewe drafting date, October 29.

Table IV gives the mean body weight (pounds) of the groups and subgroups of hoggs on June 22, after 83 days of the 183 day summer period.

Table IV. The average body weight (lb.) on June 22, 1953 of the groups and subgroups of hoggs having received four different wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	84.8	98.4	79.9	77.8	85.2
Howgate	82.4	102.6	84.7	90.4	90.0
Front	81.4	98.4	91.1	84.6	88.9
West Park	89.8	102.7	94.4	89.4	94.1
Tmt. Means	84.6	100.5	87.5	85.6	89.6

The/

The individual body weights and the analysis of variance are given in Appendix Tables 5 and 5(a).

The analysis shows that there were significant differences between the treatment group of hoggs, but no significant differences between the hoggs of the different hefts or any significant heft x wintering interaction.

The comparisons show that the away wintered group of hoggs were significantly heavier than any of the other three groups, but only negligible differences occurred between the hill, inbye and inbye ½ groups. However, the treatment means were in the same order as at the end of the wintering period.

Over the period from April 1 to June 22 the hoggs from the hill, away, inbye and inbye ½ wintered groups gained 22, 15.8, 18.5 and 20.5 pounds respectively. The average increment over all the hoggs during this period was 19.2 pounds.

The hoggs from the Boghall heft tended to be lighter than the hoggs from the other three hefts. The difference between the hoggs of the Boghall and Howgate hefts and those of the Front and West Park hefts which had previously been apparent was considerably reduced at this time. The means show that the hoggs from the Boghall heft put on 17.4 pounds of live weight over this period, while those of Howgate, Front and West Park put on 20.4, 18.3 and 21.7 pounds respectively.

At the end of the summer period, on October 29, the body weights were again taken. The mean body weights of the groups and subgroups are tabulated in Table V. Appendix Tables 6 and 6(a) give the individual weights and the analysis of variance. The analysis of variance does not show any significant differences in body weight due to the winterings, but examining the means, there was a noticeable trend for the hoggs which were away wintered to be heavier than the other three groups.

Table/

Table V. The average body weight (lb.) on Oct. 29, 1953 of the groups of hoggs (1952 trial) having received four different wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	90.9	101.7	95.4	91.1	94.8
Howgate	88.7	103.9	94.0	99.9	96.6
Front	95.1	99.0	103.4	101.9	99.8
West Park	105.4	106.3	101.9	106.6	105.0
Tmt. Means	95.0	102.7	98.7	99.8	99.1

On comparing the differences, the away wintered group of hoggs was not significantly heavier than the other three groups, but after testing individually, the away wintered group was significantly heavier ($P < .05$) than the hill wintered group. The away wintered group of hoggs was not significantly heavier, nor the hill wintered group of hoggs significantly lighter than the other two groups.

Since June 22 the hill wintered group of hoggs gained on average 10.4 pounds live weight, while the away, inbye and inbye ½ wintered groups gained 2.2, 11.2 and 14.2 pounds respectively. This made a total average live weight gain during the summer of 32.4, 18.0, 29.7 and 34.7 pounds for the hill, away, inbye and inbye ½ wintered groups of hoggs respectively.

The analysis of variance also shows that there were significant differences between the average body weights of the hoggs from each heft. The mean body weight of the hoggs from Boghall and Howgate hefts was significantly lighter than the mean body weight of the hoggs from the Front and West Park hefts.

The/

The average increment in body weight of all the hoggs from June 22 to October 29 was 9.5 pounds. Over this period the hoggs from Boghall, Howgate, Front and West Park hefts gained 9.6, 6.6, 10.9 and 10.9 pounds respectively, making a total summer gain from April 1 to October 29 of 27, 27, 29.2 and 32.6 pounds. The average live weight increment of all the hoggs over the total summer period was 28.7 pounds.

The similarity of the total summer gain for the Boghall and Howgate hefts would indicate a similarity of environment x genotype reaction. However, examining the early and late summer periods the tendency was for poorer gains to be made in the early summer period and better gains in the late summer on the Boghall heft (predominantly heather) than the Howgate heft (less heather, thinner soil). The similarity of the live weight gains of the hoggs of the Front and West Park hefts in the late summer comes after greater gains in early summer by the hoggs from the West Park heft.

(c) Growth from Eighteen Months to Maturity. The data were made more difficult to analyse because the production stresses could cause differential deaths and culls as well as differential responses in fertility. The total observations corrected for type of lambing are presented. To detect wintering differences the data were analysed as a totally randomised design. The treatment means were calculated from the total remaining corrected observations. The corrected body weights (pounds) of the ewes are given in the Appendix Tables 7 to 11. Corrections were made for the type of birth only, and ewes which had twins or were barren were adjusted to the equivalent of ewes which had reared single lambs.

Table VI gives the means of the treatment groups of ewes on April 9, 1954, before the first lambing takes place.

Table/

Table VI. The mean body weight (lb.) on April 9, 1954 (approx. 23 months of age) of the groups of ewes of the 1952 trial which received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Mean Body Weight	84.6	89.6	86.2	84.4
No. of Observations	25	27	27	27

The analysis of variance (Appendix Table 7(a)) shows that the treatments had not significantly affected the mean body weight of the groups, but the hoggs which were away wintered still remained slightly heavier than the other three groups.

From the last recorded weighing in October, 1953 to April, 1954, there was a loss in body weight (hill - 10.4 pounds, away - 13.1 pounds, inbye - 12.4 pounds and inbye ½ - 15.4 pounds).

Table VII gives the means of the body weights (pounds adjusted) of the groups of ewes after the lambs were weaned in the October of their first production year.

Table VII. The mean body weight (lb. adjusted*) on Oct. 6, 1954 (approx. 30 months of age) of the groups of ewes of the 1952 trial which received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Mean Body Weight	104.4	102.0	104.2	105.1
No. of Observations	21	26	25	25

* Adjustment made in the body weight of barren ewes (page 21)

The analysis of variance (Appendix Table 8(a)) shows that the different hogg wintering treatments had not affected the mean body weight of the groups at/

at this stage. The advantage that the away wintered group had held up to this point appeared to have disappeared, showing that the other three groups had made greater body weight gains than the away wintered group since April.

Table VIII gives the mean body weight of the groups of ewes at the end of their second production year.

Table VIII. The mean body weight (lb. adjusted*) on Oct. 1, 1955 (approx. 42 months of age) of the groups of ewes of the 1952 trial which received different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Mean Body Weights	105.0	105.6	104.7	106.1
No. of Observations	20	25	24	23

* Adjustment made in the body weight of barren ewes (page 21)

The analysis of variance, given in Appendix Table 9(a), confirmed that no significant differences in body weight attributable to the hogg wintering practices were apparent between the groups of ewes. The mean body weight was similar to that observed after the first production year, so that it appeared that maturity had been reached.

Table IX gives the mean body weight of the groups of ewes that remained after the third production year. The individual body weights are given in Appendix Table 10.

Table IX. The mean body weight (lb. adjusted*) on Oct. 2, 1956 (approx. 54 months of age) of the groups of ewes (1952 trial) which received different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Mean Body Weight	111.5	112.2	110.6	115.3
No. of Observations	17	21	18	20

* Adjustment made in the body weight of barren ewes (page 21)

The analysis of variance (Appendix Table 10(a)) shows that there were no significant treatment differences between the groups of hoggs.

Table X gives the mean body weight of the groups of ewes calculated from those remaining in each group at the end of their productive lives (September 1957), after the fourth production year.

Table X. The mean body weight (lb. adjusted*) on Sep. 12, 1957 (approx. 66 months of age) of the groups of ewes (1952 trial) which received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Mean Body Weight	111.6	115.2	119.1	119.8
No. of Observations	13	18	14	18

* Adjustment made in the body weight of barren ewes (page 21)

The table shows that in 1957, which was a particularly favourable year for hill sheep, the means of the body weights were elevated in the away, inbye and inbye ½ wintered groups, but not in the hill wintered group. The analysis of variance (Appendix Table 11(a)) indicates that the treatment effects were not significant.

Comparing the means of the body weight of the groups, on average the hill wintered group of hoggs were significantly lighter in body weight than the other three groups of hoggs tested together, but not significantly lighter than the away wintered group itself.

2. Hind Cannon Bone Length

The length of cannon bone was taken as an indicator of the effect of planes of nutrition during rearing on the development of an early maturing bone.

Treatment/

Treatment means for all the observations made on this measurement are presented in Appendix Table 13. The data are extracted and enlarged to include heft means as the relevant information comes under discussion in the text.

(a) Cannon Bone Length during the Treatment Period. Table XI shows the mean length of the cannon bone (centimetres) for the groups and subgroups of Blackface hoggs (1952 Group) at the start of the treatments.

The individual cannon bone lengths and the analysis of variance are given in Appendix Tables 14 and 14(a).

The average cannon bone length of all the hoggs was 18.13 centimetres with hoggs from the Front heft slightly shorter than average and the hoggs from the West Park slightly longer than the average. When split into the four treatment groups, minor differences did occur - the hill and away wintered groups had shorter, while the inbye and inbye ½ had longer than average hind cannon bone length. On testing, these differences reached significance at the ($P < .05$) level. The hoggs from the Front heft had shorter hind cannons than the hoggs from the West Park heft ($P < .05$).

Table XI. The mean length of the hind cannon bone (cm.) for the groups and subgroups of Blackface hoggs (1952 Group) at the start of the wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	17.8	18.2	18.5	17.9	18.10
Howgate	18.0	18.3	18.3	18.2	18.19
Front	17.9	17.9	17.8	18.1	17.93
West Park	18.1	18.0	18.7	18.5	18.31
Tmt. Means	17.95	18.08	18.33	18.17	18.13

The/

The mean cannon length for each treatment x heft group of hoggs varied from 17.8 centimetres (Boghall x hill) to 18.7 centimetres (West Park x inbye). Individual cannon bone length ranged from 16.7 centimetres to 19.4 centimetres.

Table XII shows the means of the hind cannon bone length for the groups and subgroups of hoggs midway through the wintering treatments.

Table XII. The means of the lengths of the hind cannon bone (cm.) of the groups and subgroups of hoggs on Jan. 6, 1953, midway through the wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	18.0	18.8	19.0	18.5	18.59
Howgate	18.3	18.8	18.4	18.9	18.61
Front	18.1	18.4	18.1	18.6	18.32
West Park	18.3	18.4	19.1	19.1	18.71
Tmt. Means	18.21	18.61	18.63	18.78	18.56

The individual cannon bone lengths for this period and the analysis of variance are given in Appendix Tables 15 and 15(a). Although the differences due to wintering do not reach significance ($P < .05$) in the analysis of variance, comparing the average length of cannon bone of the hill wintered group of hoggs with the remainder showed the hill wintered hoggs to have significantly ($P < .05$) shorter cannon bones.

The average cannon bone increment of all the hoggs over this period was 0.43 centimetres, while the average increment for the individual hefts was 0.49, 0.42, 0.39 and 0.40 centimetres for the hoggs of Boghall, Howgate, Front and West Park hefts respectively. The increment of the hoggs of each treatment group was 0.26, 0.53, 0.30 and 0.61 centimetres for the hill, away, inbye and/

and inbye ½ wintered groups. The different response of the inbye and inbye ½ groups of hoggs is difficult to explain as both groups were at this time receiving the same treatment.

Table XIII shows the means of the hind cannon bone length of the groups and subgroups of the hoggs (1952 trial) on April 1, 1953, on completion of the wintering treatments.

Table XIII. The means of the length of the hind cannon bone (cm.) of the groups and subgroups of Blackface hoggs (1952 trial) on April 1, 1953, at the end of the four different wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	18.4	19.5	19.6	18.7	19.06
Howgate	18.5	19.7	19.0	19.0	19.06
Front	18.3	19.2	18.7	18.7	18.73
West Park	18.4	19.0	19.7	19.0	19.02
Tmt. Means	18.40	19.37	19.20	18.80	18.97

The individual hind cannon bone lengths and the analysis of variance are given in Appendix Tables 16 and 16(a). The analysis of variance shows highly significant ($P<.01$) differences due to the treatments, but no significant differences in the hefts or significant heft x wintering interaction. The hoggs from the hill wintered group had significantly ($P<.01$) shorter cannon bones than the hoggs from the other three groups taken together. However, the difference in length of cannon between the hill wintered hoggs and the inbye ½ wintered group of hoggs did not reach significance at the ($P<.05$ level). Although the hoggs from the Front heft had on average shorter cannon bone length than the rest of the hoggs, this was not significantly so at/

at the ($P<.05$ level).

The average increase in cannon bone length of all the hoggs from January 6 to April 1 was 0.41 centimetres. The hind cannon of the hoggs from the Boghall, Howgate, Front and West Park hefts grew on average 0.47, 0.45, 0.41 and 0.31 centimetres respectively, while classified by the treatment groups, the hill, away, inbye and inbye ½ wintered groups of hoggs showed hind cannon bone increments over this period of 0.19, 0.76, 0.57 and 0.02 centimetres respectively.

For the whole wintering period from October 1, 1952, to April 1, 1953, the average increase in length of the hind cannon was 0.84 centimetres. The corresponding increments of the hoggs from the Boghall, Howgate, Front and West Park hefts were 0.96, 0.87, 0.80 and 0.71 centimetres respectively. The hoggs from the hill, away, inbye and inbye ½ wintered groups increased the hind cannon bone length by 0.45, 1.29, 0.87 and 0.63 centimetres respectively over this period.

(b) Hind Cannon Bone Length from the End of the Wintering Treatments to First Mating. Table XIV shows the mean cannon bone lengths (centimetres) of the groups and subgroups of hoggs on June 22, 1953, 83 days after the termination of the wintering treatments.

Table/

Table XIV. The mean hind cannon bone length (cm.) on June 22, 1953 of the groups and subgroups of hoggs (1952 trial) having received four different hogg wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	19.0	19.8	20.0	19.1	19.46
Howgate	19.1	19.9	19.4	19.5	19.49
Front	18.7	19.4	19.2	19.2	19.12
West Park	19.1	19.2	19.9	19.6	19.45
Tmt. Means	18.98	19.58	19.60	19.30	19.38

The individual hind cannon bone lengths and the analysis of variance are given in Appendix Tables 17 and 17(a). The analysis shows significant treatment differences (at $P<.05$ level), but no heft differences or heft x wintering interaction. Comparing the means of the hind cannon bone length of the hoggs having been given four different wintering treatments, on June 22, the group of hoggs having received the hill wintering treatment on average had significantly shorter hind cannon bones than the other hoggs. However, the inbye ½ wintered group of hoggs did not differ significantly in cannon bone length from the inbye wintered group.

The overall average increase in length of hind cannon from April 1 to June 22 was 0.41 centimetres. The individual average heft increments of hind cannon bone were 0.40, 0.43, 0.39 and 0.43 centimetres respectively for the Boghall, Howgate, Front and West Park hefts. For the treatment groups of hoggs, hill, away, inbye and inbye ½ wintered, the average increments were 0.58, 0.21, 0.41 and 0.54 centimetres respectively.

Table XV shows the means of the hind cannon bone length of the groups and subgroups of hoggs on October 29, 1953.

Table/

Table XV. The mean hind cannon bone length (cm.) of groups and subgroups of hoggs (1952 trial) on October 29, 1953, having received four different hogg wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	19.1	19.8	20.1	19.3	19.59
Howgate	19.4	19.9	19.5	19.7	19.61
Front	18.8	19.4	19.4	19.3	19.22
West Park	19.4	19.2	20.0	19.7	19.57
Tmt. Means	19.16	19.58	19.75	19.50	19.50

The individual bone lengths and the analysis of variance are given in Appendix Tables 18 and 18(a). The analysis reveals no significant differences due to winterings, hefts, or heft x wintering interaction. However, the means show that the hoggs from the Front heft were shorter in cannon bone length than those from the other three hefts and the hoggs having received the hill wintering treatment were shorter than the hoggs receiving the other treatments. Both these comparisons were significant ($P<.05$) when tested.

From June 22 to October 29 the average increment of hind cannon bone of all the hoggs was 0.12 centimetres. During this time the hoggs from the Boghall, Howgate, Front and West Park hefts increased their cannon bone length on average 0.13, 0.12, 0.10 and 0.12 centimetres respectively, while when classified by the method of wintering, the hill, away, inbye and inbye ½ groups of hoggs gained cannon bone length of 0.18, 0, 0.10 and 0.20 centimetres respectively.

Over the total summer period the average increase in cannon bone length of the hoggs was 0.53 centimetres. During this period the hoggs from the Boghall/

Boghall, Howgate, Front and West Park hefts increased this bone length by 0.53, 0.55, 0.49 and 0.55 centimetres respectively. The hill, away, inbye and inbye ½ wintering treatment groups increased their cannon bone length by 0;76, 0;21, 0.51 and 0.74 centimetres respectively.

The noticeable feature of this period was the similarity of the heft increments, the highly reduced increment of the away wintered group of hoggs and the moderately reduced increment of the inbye wintered group of hoggs.

(c) Hind Cannon Bone Development from Eighteen Months to Maturity.

The length of the hind cannon bone was not recorded in October, 1954.

Table XVI gives the length of the hind cannon bone of the groups of hoggs on October 1, 1955, after the second production year.

Table XVI. The means of the hind cannon bone lengths (cm.) on Oct. 1, 1955, of the groups of ewes having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½	Overall
Mean Cannon Bone Length	19.47	19.70	20.06	19.68	19.73
No. of Observations	18	22	22	24	86

The individual hind cannon bone lengths and the analysis of variance are given in Appendix Tables 19 and 19(a). The analysis shows no significant differences occurred due to treatment, although there was a tendency for the hill wintered group of hoggs to have a slightly shorter cannon bone measure than the other hoggs. This group, however, was slightly shorter on average than the other groups at the start of the experiment.

The means show that from October, 1953, the hill wintered group had increased the length of the cannon bone on average 0.31 centimetres, while the away/

away, inbye and inbye ½ groups increased 0.12, 0.32 and 0.17 centimetres respectively.

Table XVII shows the mean length of the hind cannon bone of the groups of ewes on October 22, 1956, after the third production year.

Table XVII. The mean hind cannon bone length (cm.) of the ewes (1952 trial) on October 2, 1956, having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½	Overall
Mean Cannon Bone Length	19.38	19.62	20.12	19.60	19.68
No. of Observations	17	20	18	20	75

The individual bone lengths and the analysis of variance are given in Appendix Tables 20 and 20(a). The analysis shows no significant differences due to the treatments and on comparing the hill wintered group of hoggs with the rest of the hoggs on the trial, the difference did not reach significance at the 95 per cent level of probability.

From October, 1955, to October, 1956, there was a reduction in cannon bone length in the hill, away and inbye ½ groups of hoggs of 0.09, 0.08 and 0.08 centimetres respectively, while the inbye wintered group gained 0.06 centimetres.

The final observation on cannon bone length was made on September 12, 1957, and the results are tabulated in Appendix Table 21. The means of the treatment groups are presented in Table XVIII.

Table/

Table XVIII. The mean hind cannon bone length (cm.) of the ewes (1952 trial) on September 12, 1957 having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½	Overall
Mean Cannon Bone Length	19.51	19.78	20.20	19.71	19.82
No. of Observations	15	19	17	19	70

The analysis of variance (Appendix Table 21(a)) discloses no significant differences between the groups due to the treatments. From October, 1956, an overall increase is shown of 0.14 centimetres, while the hill, away, inbye and inbye ½ wintering treatment groups increased respectively 0.13, 0.16, 0.08 and 0.11 centimetres.

3. Pelvic Bone Length

The pelvic bone length was taken as an indicator of the effect of different planes of nutrition during rearing on the development of a late maturing bone.

Treatment means for the observations made on this measure are presented in Appendix Table 22. As the data comes under discussion, it is extracted and enlarged to include heft means and presented in the text.

(a) Pelvic Bone Length during the Treatment Period. The means of the pelvic bone measurements of the groups and subgroups of the Blackface ewe hoggs at the start of the trial, on October 1, 1952, are given in Table XIX.

Table/

Table XIX. The mean pelvic bone length (cm.) of the ewe hoggs (1952 trial) on Oct. 1, 1952, at the start of the trial

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	19.0	18.9	19.0	18.9	18.95
Howgate	18.8	18.9	18.7	19.0	18.85
Front	19.4	18.7	18.9	19.1	19.03
West Park	19.4	19.2	19.7	19.6	19.46
Tmt. Means	19.14	18.92	19.07	19.16	19.07

The individual pelvic bone lengths and the analysis of variance are given in Appendix Tables 23 and 23(a). The analysis shows that the distribution of the hoggs from each heft into treatment groups resulted in only negligible differences in the mean pelvic length. However, significant differences were apparent between the means of the pelvic bone measure of the hoggs from each heft. Testing these differences the hoggs from the West Park heft have significantly ($P<.01$) longer pelvic bone measure than the remaining hoggs on trial.

The allocation of hoggs to the treatment groups resulted in means for the pelvic bone lengths of 19.14, 18.92, 19.07 and 19.16 centimetres for the hill, away, inbye and inbye ½ wintered groups respectively, while the overall average length was 19.07. The groups of hoggs from Boghall, Howgate, Front and West Park hefts had on average pelvic bone lengths of 18.95, 18.85, 19.03 and 19.46 centimetres respectively. Hoggs from the West Park heft had on average pelvic bones 0.43, 0.61 and 0.51 centimetres longer than Front, Howgate and Boghall hefts respectively.

Table XX shows the means of the pelvic bone length of the treatment groups and/

and heft subgroups of hoggs midway through the hogg wintering treatments.

Table XX. The means of the pelvic bone length (cm.) of hoggs (1952 trial) on Jan. 6, 1953, midway through the hogg wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	19.0	19.5	19.7	19.3	19.36
Howgate	18.7	19.8	19.0	19.6	19.27
Front	19.5	19.6	19.5	19.8	19.60
West Park	19.2	20.0	20.1	20.0	19.81
Tmt. Means	19.09	19.72	19.57	19.66	19.51

The individual pelvic bone lengths are given in Appendix Table 24 and the analysis of variance in Appendix Table 24(a). The analysis indicated significant ($P<.05$) differences in the mean pelvic bone lengths of the groups due to the wintering treatments. Comparing the mean of the hill wintered group of hoggs for this measure with the remainder of the hoggs showed that the hill wintered group of hoggs had on average significantly ($P<.01$) shorter pelvic bones at this stage than the remainder of the hoggs. Although the differences between the mean bone lengths of the hoggs from each heft at this stage were not significant, a comparison of the mean for the West Park heft with the remainder was significant ($P<.05$).

The increase in bone length of all the hoggs from October 1 to January 6 was 0.44 centimetres, Boghall heft, increasing by 0.41 centimetres, Howgate heft 0.42 centimetres, Front 0.57 centimetres and West Park 0.35 centimetres. In the treatment groups the hill wintered group of hoggs recorded a reduction in length of the pelvic bone of 0.05 centimetres, while the away, inbye and inbye/

inbye ½ wintered groups gained by 0.80, 0.50 and 0.50 centimetres respectively.

Observations were again taken on April 1, 1953, at the end of the winter treatment period. Table XXI gives the means of the groups and subgroups for the pelvic bone length, while the individual bone lengths and the analysis of variance are presented in Appendix Tables 25 and 25(a).

Table XXI. The means of the pelvic bone lengths (cm.) of the groups and subgroups of hoggs on April 1, 1953, at the end of the four different hogg wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	19.1	20.9	20.1	19.2	19.86
Howgate	18.7	21.0	19.5	19.7	19.72
Front	19.5	20.7	19.7	19.7	19.91
West Park	19.1	21.2	20.6	19.9	20.21
Tmt. Means	19.12	20.97	19.98	19.63	19.93

The analysis of variance shows highly significant ($P<.01$) differences in pelvic bone length at this stage due to treatment, but no significant heft differences or heft x wintering interaction. On comparing the mean of the other three groups separately, the pelvic bone at this time was significantly shorter in the hill wintered group. The group of hoggs which was away wintered had pelvic bones which were highly significantly ($P<.01$) longer than any of the other treated groups. Testing the comparison between the mean length of the pelvic bone of the hoggs of the West Park heft and the mean length of the pelvic bone of the rest of the hoggs did not reveal the significant difference that had been present initially and midway through the winter.

The/

The means show that the average pelvic bone increment from January 6 to April 1, 1953, was 0.42 centimetres, while the average increment of the hoggs from Boghall, Howgate, Front and West Park hefts was 0.50, 0.45, 0.31 and 0.40 centimetres respectively. The average bone increment of the hill, away and inbye wintered groups of hoggs was 0.03, 1.25 and 0.41 centimetres with the inbye ½ group of hoggs showing a decrease of 0.03 centimetres.

Over the whole treatment period from October 1, 1952 to April 1, 1953, the average increase in pelvic bone length was 0.84 centimetres, while over this period hoggs from Boghall, Howgate, Front and West Park gained 0.91, 0.87, 0.88 and 0.75 centimetres respectively. The mean increment of the hoggs on the hill, away, inbye and inbye ½ wintering treatment was -0.02, +2.05, +0.91 and +0.47 centimetres respectively.

(b) The Length of the Pelvic Bone from the End of the Wintering Treatments to First Mating. The period from April 1 to October 29, 1953, was split into two parts by observations made in mid-summer, June 22, after 83 days of the 183 day period.

Table XXII gives the means of the pelvic bones of the groups and sub-groups of hoggs midway through the summer period.

Table XXII. The means of the length of the pelvic bones (cm.) of the groups and subgroups of Blackface hoggs on June 22, 1953, having received four different hogg wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	20.2	21.3	20.6	20.2	20.58
Howgate	19.7	21.5	20.0	20.6	20.45
Front	20.4	20.9	20.3	20.5	20.51
West Park	20.1	21.2	20.9	20.7	20.72
Tmt. Means	20.10	21.24	20.45	20.47	20.57

The individual pelvic bone measurements of the hoggs at this time and the analysis of variance are given in Appendix Tables 26 and 26(a). The analysis shows significant differences between the means due to the winterings, but not to the hefts. The analysis also shows no heft x wintering interaction.

The comparison of the means of the bone length of the treatment groups of hoggs shows that the hoggs that were hill wintered had significantly ($P < .01$) shorter pelvic bones than the rest of the hoggs at this time, but the difference between the hill wintered hoggs and the inbye and inbye ½ wintered group was not significant. The away wintered group of hoggs had on average significantly ($P < .01$) longer pelvic bones than the average of any of the other three groups. The overall increase in pelvic bone length from April 1 to June 22, 1953, was 0.64 centimetres, while the average increase for hoggs from Boghall, Howgate, Front and West Park hefts was 0.72 centimetres, 0.73 centimetres, 0.60 centimetres and 0.51 centimetres respectively. The mean increment over this period for the treatment groups was hill wintered 0.98 centimetres, away wintered 0.27 centimetres, inbye wintered 0.47 centimetres and inbye ½ wintered 0.84 centimetres.

At the end of the summer period, October 29, the bone lengths were again taken and the means of the groups and subgroups are presented in Table XXIII.

Table/

Table XXIII. The means of the pelvic bone length (cm.) of groups and subgroups of hoggs (1952 trial) on Oct. 29, 1953, having received four different hogg wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	21.1	22.1	21.5	21.1	21.46
Howgate	20.8	22.3	21.0	21.5	21.37
Front	21.4	21.5	21.4	21.5	21.45
West Park	21.5	22.0	21.8	21.7	21.76
Tmt. Means	21.20	21.97	21.43	21.45	21.51

The individual bone lengths and the analysis of variance for this data are given in Appendix Tables 27 and 27(a). The analysis shows that differences between the groups of hoggs receiving different winterings were significant ($P<.05$), while differences between the means of hoggs from different hefts were not so.

Testing the differences due to treatments, the group of hoggs that were away wintered had significantly ($P<.05$) longer pelvic bones than any of the other three treated groups. The group of hoggs that had been hill wintered were shorter in the pelvic bone at this stage than the hoggs from the other three groups, but not significantly shorter than either the inbye or inbye ½ wintered groups.

The average increase in the pelvic bone length from June 22 to October 29, 1953, of all the hoggs was 0.94 centimetres. Hoggs from Boghall, Howgate, Front and West Park hefts gained 0.88 centimetres, 0.92 centimetres, 0.94 centimetres and 1.04 centimetres in length respectively, making total gains for the whole summer period from April 1 to October 29, 1953, of 1.60, 1.65, 1.54 and 1.31 centimetres respectively. The average increase over this period/

period was 1.58 centimetres.

The average increase in length of the pelvic bone was not so consistent for the treatment groups. From June 22 to October 29, 1953, the hill, away, inbye and inbye ½ wintered hoggs gained 1.10, 0.73, 0.98 and 0.98 centimetres respectively, making total gains over the summer period of 2.08, 1.00, 1.45 and 1.82 centimetres respectively.

(c) The Length of the Pelvic Bone from Eighteen Months of Age to Maturity. Table XXIV gives the mean length of the pelvic bone of the sheep of the four treatment groups from eighteen months to maturity.

The individual pelvic bone lengths and the analysis of variance are given in Appendix Tables 28, 29 and 30 for the second, third and fourth productive years respectively. From October, 1953 to October, 1955, the average increment of all the hoggs was 0.56 centimetres. Over this period the hill wintered group gained on average 0.89 centimetres, the away hogg wintered group 0.18 centimetres, the inbye wintered group 0.49 centimetres and the inbye ½ wintered group 0.68 centimetres.

Table XXIV. The mean pelvic bone length (cm.) at various dates from eighteen months of age to maturity of ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½	Overall
Pelvic Length 29/10/53	21.20	21.97	21.43	21.45	21.51
Pelvic Length 1/10/55	22.09	22.15	21.92	22.13	22.07
No. of Observations	18	23	22	23	86
Pelvic Length 2/10/56	22.15	22.19	22.05	22.10	22.12
No. of Observations	17	20	18	20	75
Pelvic Length 12/9/57	22.14	22.14	22.15	22.21	22.16
No. of Observations	15	19	17	20	71

The/

The analysis of variance shows no significant differences between the average pelvic bone length of the groups due to the hogg winterings. The advantage in pelvic length that the away hogg wintered group held previously was not apparent at this time and the reduced pelvic length of the hill hogg wintered group had also disappeared.

By the following year, October 2, 1956, there was a slight increase in average pelvic bone length of all the hoggs (0.05 centimetres). The hill, away, inbye and inbye ½ hogg wintered groups respectively gained or lost 0.06, 0.04, 0.13 and -0.03 centimetres.

In the final year from October, 1956 to September, 1957, the overall increase in pelvic bone length was only 0.04 centimetres. The treatment groups gained or lost only negligible amounts.

Production Responses to the Hogg Wintering Treatments

1. Fleece Weight

The mean annual fleece weights (pounds) of the groups of ewes are given in Appendix Table 31. At the hogg stage all the observations were available and so the analysis considered heft differences as well as treatment differences. During the production years only treatment differences were analysed.

Table XXV gives the mean fleece weights of the groups and subgroups of the hoggs, taken at clipping time - June, 1953.

Table/

Table XXV. The mean fleece weights of the groups and subgroups of the Blackface hoggs (1952 trial) taken June 1953 having received four different hogg wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	4.70	6.24	5.31	4.83	5.25
Howgate	3.93	6.10	4.27	5.01	4.83
Front	4.40	6.10	5.13	4.84	5.12
West Park	4.51	5.86	6.06	4.71	5.28
Tmt. Means	4.39	6.07	5.17	4.85	5.12

The individual fleece weights and the analysis of variance are given in Appendix Tables 32 and 32(a). The analysis shows significant ($P<.01$) differences in fleece weights due to the wintering treatments, but non-significant heft differences. There was no significant interaction between the hefts and the winterings. In the comparison of the differences due to the winterings, the away hogg wintered group had significantly ($P<.05$) heavier fleece weights than any of the other three groups. The group that had been inbye hogg wintered had significantly heavier fleece weights than the hoggs which had been hill wintered.

The mean fleece weight of all the hoggs was 5.12 pounds and the hoggs from Boghall, Howgate, Front and West Park hefts produced 5.25, 4.83, 5.12 and 5.28 pounds of wool respectively. The lighter average fleece weight of the hoggs from the Howgate heft can be attributed to the very light fleeces from the group which was hill wintered along with the lower than average fleece weight of the hoggs which were inbye wintered.

The away hogg wintered group had on average 0.9 pounds more fleece weight/

weight than the inbye hogg wintered group, 1.22 pounds more than the inbye ½ hogg wintered group and 1.68 pounds more than those hill hogg wintered. The inbye hogg wintered group had 0.78 pounds and the inbye ½ hogg wintered group 0.46 pounds heavier fleece weights than the hill hogg wintered group.

The mean fleece weights of the groups of ewes in their first production year are given in Table XXVI.

Table XXVI. The mean fleece weights (lb.) of the groups of ewes (1952 trial), taken in July, 1954, having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½	Overall
Mean Fleece Weight	5.59	5.60	5.71	5.60	5.63
No. of Observations	22	24	26	26	98

The individual fleece weights and the analysis of variance are given in Appendix Table 33. The analysis of variance shows no significant differences in mean fleece weight due to the treatments. The outstanding feature was the closeness of the group means.

Table XXVII gives the mean fleece weight of the groups of ewes in their second production year.

Table XXVII. The mean fleece weight (lb.) of the groups of ewes (1952 trial), taken in July, 1955, having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½	Overall
Mean Fleece Weight	4.79	4.79	5.07	5.15	4.94
No. of Observations	17	24	22	17	80

The/

The individual fleece weights and the analysis of variance are given in Appendix Table 34. No significant treatment differences occurred between the groups and only minor differences were evident between the means.

For the third production year, July 1956, the mean fleece weight of the groups are given in Table XXVIII.

Table XXVIII. The mean fleece weight (lb.) of the groups of ewes (1952 trial), taken in July, 1956, having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½	Overall
Mean Fleece Weight	4.87	4.78	4.66	4.50	4.69
No. of Observations	15	18	19	17	69

The individual fleece weights and the analysis of variance are given in Appendix Table 35. The analysis shows that none of the differences which occur between the treatment means were significant. Again the closeness of the mean fleece weights of the groups of ewes was the striking feature.

Table XXIX gives the mean fleece weights (pounds) of the ewes in their fourth and final production year.

Table XXIX. The mean fleece weight (lb.) of the groups of ewes (1952 trial), taken in July, 1957, having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½	Overall
Mean Fleece Weight	5.25	5.29	5.81	5.63	5.48
No. of Observations	14	17	13	15	59

The/

The individual fleece weights and the analysis of variance are given in Appendix Table 36. None of the differences in fleece weight between the means of the groups of ewes reached significance ($P < .05$).

2. Fertility

(a) Degree of Barrenness. As barrenness is a complex phenomenon and may be due to failure to conceive, the result of early embryonic death, or to early abortion, in this study it is measured by the failure of a ewe to give birth to a full term lamb.

Appendix Table 37 shows the lifetime incidence of barrenness tabulated to show distribution over the heft, year and treatment group. The incidence is expressed as a fraction of the possible observations.

Table XXX shows the annual percentage of barren ewes of each treatment group.

Table XXX. The mean yearly percentage of barren ewes of the groups of ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½	Yearly Mean
1954	12.0	11.1	0.0	22.2	11.3
1955	10.0	12.5	9.1	8.3	10.0
1956	0.0	9.5	8.7	4.5	5.7
1957	0.0	5.5	0.0	5.3	2.7
Ave. Lifetime Incidence	5.5	9.6	4.4	10.1	7.4

The table shows that as the ewes grew older, the incidence of barrenness grew less. Testing the first two production years against the second two (Appendix/

(Appendix Table 37(a)), there was a significantly ($P<.05$) higher incidence of barrenness in the first two years than in the second two. However, the analysis of variance confirms that there were no significant differences in the average lifetime incidence of barrenness between the groups which received different hogg wintering treatments. In the first production year it was the group which was inbye hogg wintered for half the winter that showed the highest incidence and the inbye hogg wintered for all the winter which showed the lowest incidence. Those ewes which were hogg wintered on the hill and those which were away wintered had similar incidence. It was not possible to test whether the differences between the groups in the first production year might have been caused by the previous wintering treatments.

(b) Frequency of Twinning. The frequency of twinning was taken as the number of ewes which gave birth to twin lambs and was used as an indicator of the effect of the treatments on the development of the reproductive organs. Appendix Table 38 shows the distribution of ewes giving birth to twin lambs by year, heft, and treatment grouping. The numbers are expressed as a fraction of the number of possible observations.

Table XXXI shows the mean annual twinning percentages of the groups of ewes.

Table/

Table XXXI. The mean yearly percentage of the groups of Blackface ewes (1952 trial) which gave birth to twin lambs, the ewes having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½	Yearly Mean
1954	4.0	29.6	18.5	11.1	15.8
1955	20.0	8.3	8.7	4.2	10.3
1956	27.8	5.0	28.6	22.7	21.0
1957	42.8	61.1	35.3	27.8	41.7
Ave. Lifetime Incidence	23.6	26.0	22.7	16.45	22.2

The analysis of variance is given in Appendix Table 38(a). There are significant differences between the years and except for the first productive year, it is noticeable that on average the percentage twinning increases with each successive production year. There were no significant differences between the average lifetime percentages of twins produced by the groups of ewes treated differently. In the first year it was noticeable that the away and inbye wintered groups produced greater numbers of twins than the hill and inbye ½ wintered groups. However, the following year the hill wintered group had a higher than average percentage, while the other three groups had lower than average percentages. In the third year the away hogg wintered group of ewes had again a lower than average twinning incidence, but in the final year this group produced a higher than average number of twins.

3. Lamb Production

(a) Birth Weight of Lambs. The birth weight (pounds) was taken of all lambs born to the ewes throughout the trial. The birth weight of the lambs is/

is taken as an indicator of the effect the treatments may have had on pre-natal development of the lambs and their strength at birth.

Table XXXII gives the average annual birth weight of the lambs from the groups of ewes and the total average production over the lifetime of the ewes. The lambs' birth weights were adjusted for type of birth and sex as given in the section on experimental procedure (page 23).

Table XXXII. The mean annual adjusted* birth weight (lb.) of the lambs from the groups of ewes (1952 trial) having received four different hoggs wintering treatments

	Hill	Away	Inbye	Inbye ½	Overall
1954	10.5	11.2	10.4	10.4	10.65
1955	8.1	7.8	8.0	7.9	7.94
1956	8.1	8.2	9.2	8.8	8.60
1957	10.0	9.3	9.3	10.0	9.62
Lifetime Tmt. Means	9.18	9.12	9.22	9.28	9.20

* Adjusted for birth type and sex (page 23).

The individual adjusted birth weights of the lambs are tabulated annually and presented in Appendix Tables 39, 40, 41 and 42 respectively for production years 1954, 1955, 1956 and 1957. The analysis of variance is given along with the tables.

Table XXXII shows that there were negligible differences between the average birth weight of the lambs over the production lifetime of the groups of ewes wintered differently. Between the years there were noticeable differences. In the first production year the average birth weight of lambs born to all the ewes was particularly high. In the second productive year there/

there was a 2.71 pound drop in average birth weight with a steady rise in the third and fourth production years.

Although the away hogg wintered group of ewes in 1954 gave birth to lambs almost a pound heavier than those from the other three groups, this was not significant ($P < .05$). In 1955 the differences were quite small, and in 1956, although the differences between the hogg wintered groups were increased, they were still not significant. In 1957 the away hogg wintered and the inbye hogg wintered ewes gave birth to lambs significantly ($P < .05$) lighter than those from the other two groups.

(b) Daily Gain to Weaning. The daily gain to weaning was calculated by subtracting the birth weight from the weaning weight and dividing by the number of days from birth to weaning. This was then corrected for type of birth and sex differences by adding or subtracting the differences between the mean of the daily gain of the single male lambs and the means of the single female, twin male and twin female lambs in any one year to or from the original single female, twin male or twin female observation.

Table XXXIII shows the mean annual daily live weight gains for the lambs from birth to weaning, from the groups of ewes (1952 trial) over their productive lifetimes.

Table/

Table XXXIII. The annual mean adjusted* daily live weight gain (lb.) from birth to weaning of the lambs born to the groups of ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½	Yearly Mean
1954	.413	.404	.422	.416	.414
1955	.511	.479	.507	.507	.500
1956	.488	.500	.478	.506	.493
1957	.582	.594	.579	.566	.582
Lifetime Average	.498	.494	.496	.499	.497

* Adjusted for birth type and sex (page 23).

The individual daily live weight gains are given for 1954, 1955, 1956 and 1957 respectively in Appendix Tables 43, 44, 45 and 46. The analysis of variance is given in each table and they show no significant differences between the mean live weight gain per day of the lambs born to each group of ewes which were hogg wintered differently. Table XXXIII shows how close the average lifetime daily gains of the lambs from each group of ewes were, while the annual average daily gain of lambs from all the ewes varied considerably. In the final production year the lambs from the groups of ewes gained approximately 8 pounds more over a hundred day period than lambs born in the second and third production years and approximately 17 pounds more than lambs born in the first production year.

4. Length of Production Lifetime of the Ewes

The number of production years the ewes remained in the flock was taken as a fraction of the total possible production years and tabulated in Appendix Table 47. The treatment totals for each heft were converted into percentages./

percentages. These data are tabulated in Table XXXIV and the analysis of variance given in Appendix Table 47(a).

Table XXXIV. The percentage of production years that the groups of ewes (1952 trial) remained in the flock, the ewes having received four different hogg wintering treatments

Heft	Hill	Away	Inbye	Inbye ½	Heft Means
Boghall	82.6	100.0	96.2	74.1	88.2
Howgate	50.0	80.8	67.8	75.0	68.4
Front	78.6	71.4	83.3	92.8	81.5
West Park	81.5	89.3	100.0	96.4	91.8
Tmt. Means	73.2	85.4	86.8	84.6	82.5

The analysis shows no significant differences due to the treatments, although there were significant heft differences in the average length of the production lifetime, or, as it may be regarded, the number remaining in the flock at the end of four production years.

It is shown in Table XXXIV that the ewes which had been hill hogg wintered tended to have on average fewer ewes remaining at the end of their four production years than the other three groups.

The overall percentage of ewes remaining after four production years from the Howgate heft was significantly ($P < .05$) lower than the overall percentage ewes remaining on the other three hefts.

Summary of the 1952 Trial Results

At the end of the wintering treatments, the average body weight of the group of hoggs which had been hill wintered was significantly lighter than the away wintered and the inbye wintered groups; the away wintered group of hoggs/

hoggs were significantly heavier than any of the other three groups. By first mating, October 29, the differences between the groups of hoggs in average body weight were considerably reduced, but in the extreme treatments the away wintered group of hoggs were significantly heavier than the hill wintered group. This difference disappeared after the first production year.

The skeletal measures followed a similar pattern to that of live weight.

In the hogg year the average fleece weight of the group which were wintered away was significantly ($P<.05$) heavier than that of any of the other three groups, while the average fleece weight of the inbye wintered group of hoggs was significantly ($P<.05$) heavier than the hoggs which had been hill wintered. In subsequent years there were no noticeable differences in the average fleece weight of the groups of ewes.

The average lifetime percentages of barren ewes in the groups were not significantly affected by the treatments. There was a tendency for the away and inbye ½ hogg wintered groups to have higher incidence than the hill and inbye groups. A reduction in the percentage of barren ewes as the ewes aged was noticed.

The lifetime average twinning percentage was similar for the hill, away and inbye hogg wintered groups of ewes with the inbye ½ wintered group slightly, but not significantly, lower. In the first production year the hill wintered had the lowest and the away wintered group the highest incidence of twinning. However, in subsequent years there were compensations to level out these differences. Apart from a particularly high average incidence of twinning in the first year, it appeared that the twinning percentage increased as the ewes aged.

The wintering method did not affect the average weight of the lambs at birth over the lifetime of the ewes, but in the first year the lambs from

the /

the away wintered group were heavier, but not significantly so, than lambs from the other three groups. In the fourth production year lambs born to the away hogg wintered and inbye hogg wintered groups were significantly lighter ($P < .05$) than the lambs born to the ewes of the other two groups. Apart from the first production year when the birth weight of the lambs was particularly high, there was a trend for the lambs to be heavier at birth as the ewes aged.

There were no significant differences in the average rate of gain of lambs born to the four treatment groups. Again there was a tendency for the rate of gain of the lambs to improve with the age of the ewe.

The percentage of production years that the ewes which had been hill hogg wintered remained in the flock tended to be lower, but not significantly so, than that of the other three groups.

1953 Trial

In this trial the fourth treatment differed from the equivalent treatment in the 1952 trial by the changing of the first half of the wintering from inbye wintering to away wintering. After January this group of hoggs were then returned to the hill ground. This group is referred to as the away ½ wintered group of hoggs.

The change was made because it was felt that, as the purpose of the treatment was to allow for a large growth increment before receiving the check, the inbye wintering, until January, had not produced the desired effect.

Growth Responses to the Hogg Wintering Treatments

1. Live Weight

(a) Body Weight Changes during the Treatment Period. The treatment means of all the live weight observations taken throughout the trial are given/

given in Appendix Table 48. As with the previous trial, as the relevant information comes under discussion, the treatment means will be extracted and presented in the text enlarged to show the heft differences.

Table XXXV gives the live weight (pounds) of the hoggs at the start of the wintering treatments (October 1, 1953), approximately 5½ months of age.

Table XXXV. The mean live weight (lb.) on October 1, 1953, of the groups and subgroups of Blackface hoggs randomly assigned from each heft to four different hogg wintering treatments

Heft	Hill	Away	Inbye	Away ½	Heft Means
Boghall	64.0	65.8	65.3	68.7	65.9
Howgate	69.0	64.5	66.8	64.2	66.1
Front	69.1	67.3	62.7	74.3	68.4
West Park	67.1	64.3	66.3	69.1	66.7
Tmt. Means	67.3	65.5	65.3	69.1	66.8

The individual body weights of the hoggs and the analysis of variance are given in Appendix Tables 49 and 49(a). The analysis of variance shows that there were no significant treatment grouping or heft grouping differences, although it can be seen from the means that the group of hoggs allocated to the away ½ wintered treatment were on average 3.8 pounds heavier than the inbye wintered group - the other two groups being intermediate. As in the 1952 trial the hoggs from the Boghall and Howgate hefts were lighter than the other two hefts, but the hoggs from the West Park heft were much lighter than their counterparts in the 1952 trial.

Examination of the heft and wintering subgroups shows a range of mean weights from 64.0 pounds to 74.3 pounds. The average body weight of all the/

the hoggs was 66.8 pounds (compared with 68.9 pounds in the 1952 trial) and ranged from 55 pounds to 80 pounds.

Table XXXVI shows the average body weight of the hoggs midway through the treatment period.

Table XXXVI. The mean live body weight (lb.) on January 7, 1954, of the groups and subgroups of Blackface hoggs (1953 trial) receiving four different hogg wintering treatments

Heft	Hill	Away	Inbye	Away ½	Heft Means
Boghall	60.5	77.3	64.7	81.0	70.9
Howgate	65.8	81.8	66.8	80.3	73.7
Front	67.5	80.7	61.3	91.8	75.3
West Park	65.1	79.8	68.7	82.7	74.1
Tmt. Means	64.7	79.9	65.4	83.9	73.5

The individual body weights of the hoggs and the analysis of variance are given in Appendix Tables 50 and 50(a). The analysis shows that there were no significant differences between the groups of hoggs from each heft, but there were significant differences ($P<.01$) between the treatment means and also a significant ($P<.05$) heft x wintering interaction.

Comparing the mean body weights of the hill and inbye wintered hoggs with those away wintered (Away and Away ½ groups were treated the same at this period) showed that the away wintered groups of hoggs were significantly ($P<.01$) heavier than the other two groups. The inbye wintered group of hoggs were only slightly heavier than those remaining on the hill.

The presence of the significant heft x wintering interaction shows that some other factors were causing variation apart from the heft and treatment differences.

The average increase of all the hoggs from October 1, 1953, to January 7, 1954, was 6.7 pounds. Hoggs from Boghall heft gained 5.0 pounds, Howgate heft 7.6 pounds, Front heft 6.9 pounds and West Park heft 7.4 pounds. The hoggs that were wintered on the hill lost on average 2.6 pounds body weight, while the groups of hoggs wintered away, inbye and away ½ gained on average 14.4 pounds, 0.1 pounds and 14.8 pounds respectively.

Table XXXVII shows the average body weights of the groups and subgroups on April 1, 1954, at the end of the wintering treatments. After this date all the hoggs returned to the hill.

Table XXXVII. The mean body weight (lb.) on April 1, 1954, of the groups and subgroups of Blackface hoggs (1953 trial) at the end of the four different hogg wintering treatments

Heft	Hill	Away	Inbye	Away ½	Heft Means
Boghall	52.2	71.7	53.1	62.3	59.8
Howgate	53.8	74.5	54.7	57.7	60.2
Front	56.0	78.0	49.7	68.5	63.0
West Park	55.0	76.7	53.8	64.5	62.5
Tmt. Means	54.2	75.2	52.8	63.2	61.4

The individual body weights and the analysis of variance are given in Appendix Tables 51 and 51(a) respectively.

The analysis shows significant ($P<.01$) differences between the mean body weights of the hoggs wintered differently, but no significant heft differences or heft x wintering interaction. The comparisons show that the away wintered group of hoggs were on average significantly ($P<.01$) heavier than any of the other three groups. Also the away ½ wintered group of hoggs were heavier than either the inbye or hill wintered groups.

Over/

Over the whole of the wintering period from October 1 to April 1, there was an average loss in body weight of 5.4 pounds. Hoggs from the Boghall, Howgate, Front and West Park hefts lost 6.1, 5.9, 5.4 and 4.2 pounds body weight respectively over this period. The hill wintered group of hoggs lost 13.1 pounds body weight on average, the away wintered group gained 9.7 pounds, the inbye wintered group lost 12.5 pounds, and the away ½ wintered group lost 5.9 pounds body weight.

(b) Body Weight Changes from the Wintering Treatment to First Mating. This period was again split into two. The body weights were taken on June 16, 1954, and on October 6, 1954. Table XXXVIII gives the body weight of the groups and subgroups of hoggs on June 16, 77 days after returning to their particular hefts on the hill.

Table XXXVIII. The mean body weight (lb.) of the groups and subgroups of Blackface hoggs (1953 trial) on June 16, 1954, having received four different hogg wintering treatments

Heft	Hill	Away	Inbye	Away ½	Heft Means
Boghall	67.5	84.2	74.0	80.0	76.4
Howgate	76.7	87.8	79.0	81.3	81.2
Front	82.8	90.5	69.0	95.0	84.3
West Park	78.0	87.1	80.1	85.0	82.6
Tmt. Means	76.2	87.4	75.5	85.3	81.1

The individual body weights are given in Appendix Table 52. The analysis of variance, given in Appendix Table 52(a) shows no significant wintering differences or heft differences, but a significant heft x wintering interaction.

On/

On comparing the mean body weights of the hoggs that had been hill and inbye wintered with those that had been away and away ½ wintered, the difference between them accounted for most of the variance between the wintering treatment groups and was highly significant ($P<.01$).

The average live weight increase of all the hoggs over this period was 19.7 pounds. The Boghall, Howgate, Front and West Park hefts showed average live weight increases of the hoggs of 16.8 pounds, 21.0 pounds, 21.3 pounds and 20.1 pounds respectively. The hoggs which were wintered on the hill gained 22.0 pounds, the away wintered group 12.2 pounds, while the inbye and away ½ groups gained 22.7 and 22.1 pounds respectively.

To examine the heft x wintering interaction the increments over this period of the subgroups are given in Table XXXIX.

Table XXXIX. The increment (lb.) of the body weight of groups of hoggs (1953 trial) from April 1, to June 16, 1954, having received four different hogg wintering treatments

Heft	Hill	Away	Inbye	Away ½	Heft Means
Boghall	15.3	12.5	20.9	17.7	16.8
Howgate	22.9	13.3	24.3	23.6	21.0
Front	26.8	12.5	19.3	26.5	21.3
West Park	23.0	10.4	26.3	20.5	20.1
Tmt. Means	22.0	12.2	22.7	22.1	19.7

The presence of the heft x wintering interaction indicated that the groups of hoggs had not increased in body weight as would be expected from the average of the treatment and heft effects. Examining the group increments over this period, it is evident that the hoggs from Boghall heft made

poor/

poor gains compared with those from the other three hefts. Exception to this was in the group of hoggs that had been away wintered. The hoggs from the Front heft had made good gains over this period, except the group of hoggs that had been inbye wintered. This group was the lightest group at the start of the experiment. In the West Park heft those hoggs which had been wintered away for the whole of the winter and for half the winter did not respond as well as should have been expected considering the mean treatment and heft responses.

Table XL shows the mean body weight of the groups of hoggs at the end of the summer period, October 6, 1954.

Table XL. The mean body weight (lb.) of the groups and subgroups of Blackface hoggs (1953 trial) on October 6, 1954, having received four different hogg wintering treatments

Heft	Hill	Away	Inbye	Away ½	Heft Means
Boghall	87.5	98.8	95.2	101.0	95.6
Howgate	100.2	103.8	100.3	103.5	101.9
Front	101.0	100.2	92.2	111.0	101.1
West Park	98.5	100.2	97.7	101.0	99.3
Tmt. Means	96.8	100.7	96.3	104.2	99.5

The individual body weights are given in Appendix Table 53 and the analysis of variance in Appendix Table 53(a).

The analysis shows that the differences due to winterings did not reach significance ($P < .05$). The heft differences did not reach significance ($P < .05$) either, and the heft x wintering interaction which was apparent in June was not present at this recording.

In/

In the comparison between the mean body weights of the hoggs from the hill and inbye wintered groups with that of the away and away ½ wintered groups the difference was significant ($P < .05$). The away ½ wintered group of hoggs were significantly ($P < .05$) heavier than any of the other three groups of hoggs.

In the hefts the difference between the mean body weight of the hoggs from Boghall heft and the hoggs from the other three groups appraoched significance ($P < .05$).

The average body weight increase of all the hoggs from June 16 to October 6, 1954, was 18.4 pounds.

The hoggs from the Boghall, Howgate, Front and West Park hefts gained 19.2, 20.7, 16.8 and 16.7 pounds respectively, making a total for the period from April 1 to October 6, 1954, of 36.0, 41.7, 38.1 and 36.8 pounds respectively.

The hoggs having received different hogg winterings gained on average from June 16 to October 16, 1954, 20.6, 13.3, 20.8 and 18.9 pounds respectively, for the hill, away, inbye and away ½ groups, making a total summer gain from April 1 to October 6, 1954, of 42.6, 25.5, 43.5 and 41.0 pounds respectively. The average live weight increase of all the hoggs from April to October, 1954, was 38.1 pounds.

(c) The Body Weights from Eighteen Months to Maturity. The body weights were taken annually in October during the production years of the sheep's life. Adjustment in body weight was made for those ewes bearing twins and also those ewes which were barren. The adjustment was made as described on page 22 and the data presented as equivalent to all ewes rearing single lambs.

Table XLI shows the mean live weight of the groups of hoggs after their first production year.

Table/

Table XLI. The mean adjusted* body weight (lb.) of the groups of Blackface ewes (1953 trial) on October 1, 1955, having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½	Overall
Mean Body Weight	99.7	99.7	98.4	104.0	100.5
No. of Observations	20	22	23	24	89

* Adjusted to equivalent of having reared a single lamb

The individual body weights and the analysis of variance are given in Appendix Table 54. Although the overall test for treatment differences did not reach significant ($P<.05$), the comparison between the away ½ wintered group and the other treated hoggs showed that the away ½ wintered group were significantly ($P<.05$) heavier than their contemporaries. The average increase of all the sheep on the trial from October, 1954 to October, 1955 was 1 pound. The group that had been hill wintered increased their body weight on average 2.9 pounds over the period, while the group that had been away hogg wintered lost 1 pound body weight. The group that had been inbye wintered gained 2.1 pounds and the away ½ wintered group remained the same.

The groups were not strictly comparable from year to year, or even between themselves within a year because of the reduction in observations over the period.

Table XLII shows the mean body weight of the group of hoggs at the end of the second productive year.

Table/

Table XLII. The mean adjusted* body weight (lb.) of the groups of Blackface ewes (1953 trial) on October 2, 1956, having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½	Overall
Mean Body Weight	107.8	104.5	103.8	109.2	106.3
No. of Observations	17	23	18	22	80

* Adjusted to equivalent of ewes having reared a single lamb.

The individual body weights and the analysis of variance are given in Appendix Table 55. Again the analysis shows no overall significant ($P < .05$) treatment differences, but the away ½ wintered group were significantly ($P < .05$) heavier than the mean of the remaining hoggs. However, the away ½ wintered group were not significantly ($P < .05$) heavier than the hill wintered group.

There was an overall increase in average body weight over this period (October, 1955 - October, 1956) of 5.8 pounds. The gains made by the hill, away, inbye and away ½ wintered groups were 8.1, 4.8, 5.4 and 5.2 pounds respectively.

Table XLIII shows the mean body weights of the groups of ewes after the third production year.

Table/

Table XLIII. The mean adjusted* body weight (lb.) of the groups of Blackface ewes (1953 trial) on October 6, 1957, having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½	Overall
Mean Body Weight	121.3	120.2	118.4	125.9	121.6
No. of Observations	17	22	14	18	71

* Adjusted to the equivalent of having reared a single lamb.

The individual body weights and the analysis of variance are given in Appendix Table 56. The treatment differences did not reach significance ($P<.05$), but the group which were away ½ wintered were still significantly heavier ($P<.05$) than the remaining animals on the trial. 1957 was a very favourable year for hill sheep and the overall live weight gain from October, 1956 to October, 1957 of 15.3 pounds reflects this. The hill, away, inbye and away ½ wintered groups of ewes gained over this period 13.5, 15.7, 14.6 and 14.7 pounds respectively.

2. Skeletal Measurements

It was not possible to continue the skeletal measurements in the 1953 trial due to the time and labour involved.

Production Responses to the Hogg Wintering Treatments

1. Fleece Weights

The mean annual fleece weights of the four groups of ewes are given in Appendix Table 58. The data are extracted and presented in the text by individual years.

Table XLIV gives the means of the fleece weights of the groups and sub-groups as hoggs taken at clipping time, June 1954.

Table/

Table XLIV. The mean fleece weights (lb.) of the groups and sub groups of the Blackface hoggs (1953 trial), taken in June 1954, having received four different hogg wintering treatments

Heft	Hill	Away	Inbye	Away ½	Heft Means
Boghall	4.63	6.58	5.04	6.32	5.64
Howgate	4.33	6.30	4.12	5.12	4.97
Front	4.92	6.95	4.80	5.80	5.61
West Park	4.47	6.20	5.30	6.38	5.59
Tmt. Means	4.59	6.51	4.81	5.90	5.45

The individual fleece weights and the analysis of variance are given in Appendix Tables 59 and 59(a) respectively.

The analysis shows significant treatment differences, but non-significant heft differences and no significant heft x wintering interaction. Hoggs from the Howgate heft were significantly lighter in average fleece weight than the average of the remainder of the hoggs on trial. The differences between the average fleece weights of the hoggs from the Boghall, Front and West Park hefts were very small.

The hoggs which had received the away wintering were significantly heavier ($P<.05$) than the away ½ wintered group. However, the difference in average fleece weight between the hill wintered group and the inbye wintered group was not significant, but the fleece weight of the inbye wintered group was on average 0.22 pounds heavier than the hill wintered group.

Table XLV gives the mean fleece weight of the groups of ewes in the first production year. The individual fleece weights and the analysis of variance are given in Appendix Table 60. The analysis shows no significant differences between the means of the groups due to the winterings. However, the

away/

away wintered group of hoggs were 0.41 pounds heavier in fleece weight than the hill wintered group, 0.51 pounds heavier in fleece weight than the inbye wintered group and 0.32 pounds heavier than the away ½ wintered group.

Table XLV. The mean fleece weight (lb.) of the groups of Blackface ewes (1953 trial) in July 1955, having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½	Overall
Mean Fleece Weight	4.79	5.23	4.69	4.91	4.92
No. of Observations	22	22	18	23	85

Table XLVI gives the mean fleece weight of the groups of ewes in their second production year.

Table XLVI. The mean fleece weight (lb.) of the groups of Blackface ewes (1953 trial) in July 1956, having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½	Overall
Mean Fleece Weight	4.55	4.87	4.34	4.60	4.61
No. of Observations	18	23	19	20	80

The individual fleece weights and the analysis of variance are given in Appendix Table 61. The analysis of variance shows that there were no significant differences between the treatment groups. The means still reflected the tendency for the average fleece weight of the away wintered group to be slightly heavier than the away ½ wintered group and this group to be slightly/

slightly heavier than the hill and inbye wintered groups.

The mean fleece weights of the groups of ewes in their third production year are given in Table XLVII.

Table XLVII. The mean fleece weight (lb.) of the groups of Blackface ewes (1953 trial) taken in July 1957, having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½	Overall
Mean Fleece Weight	4.89	5.45	5.32	5.62	5.36
No. of Observations	14	20	14	20	68

The individual fleece weights and the analysis of variance are given in Appendix Table 62. The analysis shows no significant differences due to the hogg wintering treatment, although there was a tendency for the hill wintered group to be lighter in fleece than the other three groups. However, the order of the groups from heaviest to lightest changed from the previous production years.

The mean fleece weights of the groups of ewes in the fourth production year are given in Table XLVIII.

Table XLVIII. The mean fleece weight (lb.) of the groups of Blackface ewes (1953 trial) taken in July 1958, having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½	Overall
Mean Fleece Weight	4.65	5.56	4.98	5.03	5.11
No. of Observations	10	16	12	14	52

The/

The individual fleece weights and the analysis of variance are given in Appendix Table 63. The analysis shows that the differences between the means were not significant. On testing the difference between the away wintered group and the hill wintered group, the former had significantly ($P < .05$) heavier fleece weight than the latter. The other two groups were intermediate.

2. Fertility

(a) Degree of Barrenness. The annual incidence of barrenness is recorded in Appendix Table 64. It is expressed as a fraction of the total possible observations. Table XLIX shows the annual total incidence of barrenness in the treatment groups of ewes expressed as a percentage.

Table XLIX. The mean yearly percentage of barren ewes of the groups of Blackface ewes (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½	Yearly Means
1955	13.6	8.3	0	0	5.47
1956	9.1	8.3	13.6	4.3	8.82
1957	10.5	13.6	5.5	5.0	8.65
1958	5.3	20.0	0	0	6.32
Average Lifetime %	9.62	12.55	4.77	2.32	7.32

The analysis of variance, given in Appendix Table 64(a), shows that the differences between years and the differences between treatment groups were not significant. Testing the comparison between the away and away ½ wintered groups, the away ½ wintered group of ewes had a significantly ($P < .05$) lower incidence of barrenness than the away wintered group. None of the other differences between the means of the treatment groups reached significance ($P < .05$)./

($P < .05$).

The noticeable feature was that the highest incidence of barrenness occurred in the away wintered group with the hill wintered group next highest. The average lifetime incidence was 7.32 and the inbye and away ½ wintered groups had lower than average lifetime incidence.

There was no difference in years and no noticeable tendency for barrenness to be reduced with the age of the ewes.

An examination of the yearly treatment means showed that in the first production year the incidence of barrenness was highest in the hill wintered group with away wintering next. In the second production year the inbye wintered group had the highest incidence with the hill and away wintered groups slightly less. In the third production year again the hill and away wintered groups tended to have higher than average incidence of barrenness, while in the final production year, the away wintered group of ewes had a particularly high incidence. It appeared that the two extreme treatments produced the highest incidence of barrenness.

(b) Frequency of Twinning. The number and distribution of ewes giving birth to twin lambs is given in Appendix Table 65. The numbers are expressed in each heft as a fraction of the total possible observations. The annual totals for each treatment group are converted to percentages and tabulated in Table L.

Table/

Table L. The mean yearly percentage of Blackface ewes (1953 trial) which gave birth to twin lambs, the groups of ewes having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½	Yearly Mean
1955	4.8	0	0	8.3	3.27
1956	0	12.5	0	17.4	7.47
1957	15.8	27.3	11.1	35.0	22.30
1958	44.4	15.8	46.1	31.2	34.37
Ave. Lifetime Twinning %	16.25	13.90	14.30	22.97	16.85

The analysis of variance of this data, given in Appendix Table 65(a), shows that there were no significant differences between the groups of ewes which received different hogg wintering treatments in the lifetime production of twins. The away ½ wintered group of ewes tended to give birth to slightly more twin lambs than any of the other three groups.

There was a significant difference ($P < .01$) between years in twinning percentage and there appeared to be an increase in incidence of twinning as the ewes grew older. Over the four years the average annual twinning rate was 16.85 per cent.

Within the years it is noticeable that in the fourth production year the group of ewes that had been away hogg wintered had a much lower twinning percentage than the other three groups. However, in the second and third production years the away and the away ½ wintered groups of ewes had superior twinning rates than the hill and inbye wintered groups.

3. Lamb Production

(a) Birth Weight of Lambs. The birth weights of the lambs used were adjusted/

adjusted for type of birth and sex by the procedure outlined in the Methods section (page 23). The adjusted birth weights are tabulated in Appendix Tables 66, 67, 68 and 69 for each of the production years of the ewes. The analysis of variance for each year is also given. The mean annual birth weights of the lambs born to the groups of ewes are given in Table LI.

Table LI. The mean annual adjusted* birth weight (lb.) of the lambs from the groups of ewes (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½	Overall
1955	7.40	7.92	7.79	8.25	7.88
1956	8.73	8.51	9.08	8.84	8.78
1957	10.08	9.54	9.68	8.99	9.55
1958	9.31	9.65	9.12	9.60	9.43
Ave. Lifetime Birth Weight	8.88	8.90	8.92	8.92	8.91

* Adjusted for birth type and sex.

The average birth weights of the lambs from the groups of ewes treated differently in the hogg wintering period showed no noticeable differences. Over the four years the average birth weights were remarkably similar. Between years there were noticeable differences, 1955 being a year when the average birth weights were low -7.88 pounds, 1956 they averaged 8.78 pounds and 1957 and 1958 9.55 and 9.43 pounds respectively.

In their first production year, 1955, there were differences in average birth weight of the lambs from the groups of ewes. The analysis of variance (Appendix Table 66(a)) shows that these differences were not significant ($P < .05$), but testing separately shows that the difference between the birth weights/

weights from the ewes hogg wintered on the hill and those from ewes wintered away for half the year was significant at ($P<.05$). The hill wintered group of ewes produced lambs which averaged 7.40 pounds, with the lambs from the away ½ wintered group of ewes 8.25 pounds. The other two groups were intermediate.

In the second production year the average birth weight of lambs was similar to the four groups of ewes.

In 1957, the third production year, it was the hill wintered group of ewes which gave birth to the heaviest lambs (10.08 pounds), while the lambs from the away ½ wintered group of ewes were the lightest (8.99 pounds). The other two groups were intermediate. The difference in average birth weights of lambs from the hill and away ½ wintered groups of ewes was significant ($P<.05$). This year was the complete reverse of the first production year.

In 1958, the final production year, there were no noticeable differences between the average birth weights of the lambs from the groups of ewes.

(b) Daily Gain to Weaning. The same adjustments were made and the same method of calculation was used as in the 1952 trial (page 23). The daily gain (pounds) of the lambs born to the groups of ewes in 1955, 1956, 1957 and 1958 are recorded, along with the analysis of variance, in Appendix Tables 70, 71, 72 and 73.

Table LII records the mean annual growth rate of the lambs from each group of ewes.

Table/

Table LII. The annual mean adjusted* daily live weight gain (lb.) from birth to weaning of the lambs born to the groups of ewes (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½	Yearly Means
1955	.438	.485	.476	.485	.474
1956	.486	.490	.463	.501	.486
1957	.537	.559	.557	.573	.557
1958	.515	.546	.534	.525	.524
Lifetime Ave.	.494	.520	.507	.521	.511

* Adjusted for birth type and sex.

The analysis of variance of this data (given in Appendix Table 74) shows that over the four production years there were significant differences in the average growth rate of lambs from ewes of each treatment group. There were wide differences in lamb growth rate between the years.

Over the four production years the average growth rate of the lambs from birth to weaning from the ewes which had been hogg wintered on the hill and those which had been hogg wintered inbye were significantly ($P < .05$) lower than the lambs from the other two groups of ewes.

In the first production year the lambs from the hill wintered ewes had significantly ($P < .01$) lower growth rates than the lambs from the other three groups.

In the second production year, although not reaching significance, the lambs from the inbye wintered ewes tended to be lower and the lambs from the away ½ wintered ewes tended to be higher than average in rate of growth from birth to weaning.

In/

In the third production year the differences between the average daily rate of gain of the lambs from the four groups of ewes were again not significant, but the average growth rate of lambs from the away ½ wintered group of ewes tended to be greater than that of lambs from the other three groups.

In the final year no noticeable differences occurred in the mean growth rate of the lambs from the groups of ewes.

4. The Length of the Production Lifetime of the Ewes

The number of production years that the ewes remained in the flock is expressed (Appendix Table 75) as a fraction of the possible observations. The totals for the hefts of each treatment were converted into percentages and are tabulated in Table LIII. The analysis of variance is given in the Appendix Table 75(a).

Table LIII. The percentage production years the Blackface ewes (1953 trial) remained in the flock having received four different hogg wintering treatments

Heft	Hill	Away	Inbye	Away ½	Heft Means
Boghall	87.5	100.0	81.8	100.0	92.30
Howgate	87.5	90.5	95.6	81.8	88.85
Front	87.5	100.0	70.0	100.0	89.37
West Park	95.6	100.0	100.0	100.0	98.90
Tmt. Totals	89.5	97.6	86.8	95.4	92.33

The analysis of variance shows no significant differences occurred between the means of the treatment groups or between the means for the hefts. There was a trend for the percentage ewes remaining after four years to be lower in the hill and inbye wintered groups of ewes than the other two groups.

The/

The percentage ewes remaining after four production years from the Howgate and Front hefts tended to be lower than the percentage remaining from the other two hefts.

Summary of the 1953 Trial Results

At the end of the wintering treatment period the group of hoggs which had been away wintered were significantly ($P < .01$) heavier on average than the other three groups and the group of hoggs which had been away wintered for half the winter were significantly ($P < .05$) heavier than the hill and inbye wintered groups.

By first mating, October 6, the differences between the groups had been reduced. The group of hoggs which had been away ½ wintered were significantly heavier than any of the other three groups, but as the group had a slight initial weight advantage, this cannot be regarded as a real treatment effect. The away wintered group were still slightly heavier at this stage than the hill and inbye wintered groups, but not significantly so, and at the end of the first production year this difference was not apparent. The initial weight advantage of the away ½ wintered group of hoggs was retained throughout the experiment.

In the hogg year the average fleece weight of the groups was significantly affected by the wintering. The away wintered group of hoggs had significantly heavier ($P < .05$) fleece weights than any of the other groups and the hoggs which were away ½ wintered had heavier fleece weights than the hill or inbye wintered groups. In the production years the average fleece weight of the hill wintered and inbye wintered groups tended to be slightly lower than the away and away ½ hogg wintered groups, but not significantly so. In the fourth production year the average fleece weight of the hill wintered/

wintered group was significantly ($P < .05$) lighter than that of the away wintered group.

The away ½ wintered group of hoggs had a significantly ($P < .05$) lower incidence of barrenness throughout the production years than the away wintered group, the other two groups being intermediate. The incidence of barrenness did not appear to decline with age.

The average lifetime percentage of twin lambs being born to the away ½ hogg wintered group tended to be greater than in the other three groups, but the difference was not significant ($P < .05$). There was a tendency for the twinning to increase with the age of the ewe.

No noticeable differences appeared in the average birth weight of lambs of the groups of ewes, but there was a noticeable tendency for the birth weight of the lamb to increase with the age of the ewe. In the first production year the birth weight of the lambs born to the away ½ hogg wintered group of ewes was significantly ($P < .05$) heavier than of those born to the hill hogg wintered group. In the third production year this finding was reversed.

The live weight gain to weaning of the lambs born to the away and away ½ hogg wintered group of ewes was, over the four production years, significantly ($P < .05$) greater than that of the lambs of the other two groups. In the first production year the average live weight gain of the lambs of the hill hogg wintered group of ewes was significantly ($P < .01$) lower than that of the lambs of the other three groups.

No significant differences were found between the groups of ewes in the percentage of production years the ewes remained in the flock. There was a tendency for the groups of ewes which had been hill hogg wintered and those which had been inbye hogg wintered to have a lower percentage of production years than the away and away ½ hogg wintered groups.

DISCUSSION OF RESULTS

Evaluation of the Hogg Wintering Treatments

As this study covers only two years of a series of trial years, it is convenient to characterise the method of wintering of the groups of hoggs by a measurement of the live weight changes during this period. It is appreciated that there are dangers of misinterpretation in regarding as similar the composition of the live weight gains made in the different years and as a result of the different wintering methods.

Several factors have been shown to affect the composition of live weight gains. As an animal matures, it lays down tissues of higher energy values. In the trial being reported the initial body weight of the hoggs was similar in the two years. However, Kleiber (1936) has shown that even over the same weight range, animals of different potential size may lay down tissue of different composition. In the trial being reported, as the sires of the hoggs were changed in the second trial year, there may be small differences in potential size, but these were not apparent from the adult body weights.

Body weight differences may also be due to differences in the weight of the gut. Whiteman et al. (1954) have shown that differences in the ration can cause differences in the weight of the "fill" of the alimentary tract. Crichton et al. (1959) have shown that part of the increased gains of stock made on a more fibrous diet was due to increased "fill." Hendrickson et al. (1959) reported similar findings. Wherever possible in the trial being reported, the groups of hoggs were run together on the same pasture followed by a five hour fast before weighing. Meyer et al. (1960), however, have since shown that in cattle a ten to fifteen hour fast was only partially successful in reducing the variation due to the effect of the treatment on

gut/

gut "fill." Increase in "fill" cannot be ignored as a factor affecting the body weight differences of the groups.

Hendrickson et al. (1959) have shown that animals fed to make faster gains lay down carcase tissue, over a given weight range, of higher energy value than similar type cattle fed for moderate gains. As the composition of the gains was not observed, no information is available as to whether the gains made by the hoggs of the away wintered group were of higher energy value than the hoggs of the other groups, or conversely whether the tissues of the hill wintered hoggs were more depleted in fat per unit of tissue than those of the other groups.

Over the two years wide differences in live weight responses to corresponding wintering treatments occurred. This has also been reported by Jones (1958), Smith (1953) and Davies (1954). Table LIV shows that not only did the total live weight responses of the groups of hoggs differ between years and between treatments, but differences occurred in the timing of the gains and losses over the wintering period.

The hill wintered group of hoggs lost 6 pounds more body weight in the 1953 trial than in the 1952 trial. The major loss in the 1952 trial occurred in the period before January, while in the 1953 trial it occurred in the period after January. In both trials the loss in body weight was greater than that of -5.3 pounds reported by Davies (1954) in the Welsh trials of 1950-51. Without other evidence, it would appear that body weight losses of this magnitude could be expected in the hoggs kept on this hill throughout the winter. Losses in live weight of the hoggs from each heft were similar, except in the 1952 trial, when hoggs from the West Park heft lost, inexplicably, double that of the other three groups.

Table LIV/

Table LIV. The average live weight changes (lb.) over the first and second halves and the total period of the wintering treatment of the groups of hoggs having received four different hogg wintering treatments

	Hill		Away		Inbye		Inbye/Away ½	
	1952	1953	1952	1953	1952	1953	1952	1953
Oct. - Jan.	-6.4	- 2.6	3.6	14.4	4.2	0.1	4.8	14.8
Jan. - Apr.	-0.7	-10.5	13.0	-4.7	-3.8	-12.6	-9.0	-20.7
Total	-7.1	-13.1	16.6	9.7	0.4	-12.5	-4.2	- 5.9

In the away wintered groups of hoggs those of the 1952 trial made, on average, 6.9 pounds greater body weight gain than did those of the 1953 trial. This is similar to the between year difference of the hill treatment. As in the hill wintered group, the greater gain was made in the second half of the winter in 1952, whereas, in 1953, the greater gain was in the first half. The body weight gains of 16.6 and 9.7 pounds compares with those reported by Smith (1953) of 19.5 pounds and by Davies (1954) of from 1.4 pounds to 15.2 pounds at different centres and in different years. The average difference in weight gain between the hill and away wintering methods was approximately 22 and 23 pounds in 1952 and 1953 trials respectively. No trend was observable in the responses of the hoggs from the different hefts to the away wintering treatment.

Between the two groups of hoggs which were inbye wintered a difference in body weight response of 12.9 pounds in favour of the 1952 trial occurred. This was greater than the 6.0 and 6.9 pounds' difference reported for the hill and away wintered groups. This may be partially explained by the fact that in 1952 the inbye wintering was on a newly reseeded pasture, while in 1953 it was the second year of that reseed. In the inbye wintered group of the 1952 trial/

trial, unlike the previously mentioned two treatments, the major gain was in the first part of the winter, while in the 1953 trial a loss as great as that of the hoggs on the hill wintering occurred in the second part of the winter. No reports were found to substantiate the repeatability of these gains or losses, but it would appear that in both years, in the second half of the winter at least, the inbye wintering was no better than the hill wintering in maintaining body weight. It could be seen from intermediate weighings that this occurred because the herbage at this altitude did not start spring growth until after the hoggs had been returned to the hill. No great differences occurred in the gains made by the hoggs from the different hefts.

The fourth treatment group was not strictly comparable between years, but the total winter loss in body weight of the two groups of hoggs was similar. However, in the 1953 trial the treatment was more extreme, there being a 10 pound greater gain in the first half and an 11.7 pound greater loss in the second half of the winter period than in the 1952 trial. In neither year was the total loss in body weight of the hoggs put back on to the hill in January as great as that lost by the hill wintered hoggs. In 1952 and 1953 the hoggs which were returned to the hill in January lost 8.3 pounds and 10.2 pounds more in body weight respectively over the January - April period than did the hoggs which were hill wintered. The hoggs from the different hefts reacted similarly to the wintering method.

The body weight responses appeared to characterise the wintering method. Hoggs wintered on the hill could be expected to make a little growth in the early part of the wintering period before the hill herbage declined too far. Unless it was a particularly early spring, then no further live weight gains could be expected until April or May. The hoggs wintered away on good lowland pastures would go to a flush of grass, which would allow live weight gains/

gains to be made, and even though later there was a deterioration in the plane of nutrition, unless it was a particularly late spring, the growth made in March would enable further body weight gains to be made. This was borne out by intermediate weighings. The hoggs which were wintered on the improved inbye field of the hill farm also went to a flush of grass, enabling gains to be made in the early part of the winter. However, under the higher altitude and exposure, the sward did not commence its growth sufficiently early in spring for further live weight gains to be made. Hence, in the second half of the winter period there appeared to be no advantage in the inbye wintering method over the hill wintering. In the fourth treatment group, in 1952, the hoggs wintered inbye were returned to the hill in January and lost greater body weight from January to April than did the hoggs either wintered on the hill for the whole period or those remaining on the inbye field. It is generally accepted that a change in herbage is an upsetting factor in ruminant nutrition. It would appear that changing the hoggs from the inbye field to the hill was responsible for these greater weight losses. In the 1953 trial, although the hoggs were wintered away for the first part of the winter, the hoggs returning to the hill in January lost 10.2 pounds more in body weight from January - April than those which had remained on the hill, 8.1 pounds more than those wintered inbye over the period, and 16 pounds more than those remaining on the away wintering.

The Effect of the Hogg Wintering Treatments on Body Weight at First Mating

The period from the end of the hogg wintering to first mating (April - November) is one of ample nutrition on the hill allowing for growth, development and recovery from the wintering treatments.

Table LV shows the average body weight of the groups of hoggs at the start/

start and finish of the summer period and the live weight gains made in the first (April - June) and second (June - October) halves.

Table LV. The mean body weight (lb.) at 1st mating and the mean summer gain (lb.) of the groups of hoggs having received four different hogg wintering treatments

	Hill		Away		Inbye		Inbye/Away ½	
	1952	1953	1952	1953	1952	1953	1952	1953
Body Wt. at April 1	62.6	54.2	84.7	75.2	69.0	52.8	65.1	63.2
Body Wt. at 1st Mating	95.0	96.8	102.7	100.7	98.7	96.3	99.8	104.2
Gain Apr. - June	22.0	22.0	15.8	12.2	18.5	22.7	20.5	22.1
Gain June - Oct.	10.4	20.6	2.2	13.3	11.2	20.8	14.2	18.9
Total Summer Gain	32.4	42.6	18.0	25.5	29.7	43.5	34.7	41.0

The hoggs which were hill wintered in both trial years made identical live weight increases (22.0 pounds) in the first half of the summer, but in the second half the gains made by the hoggs of the 1952 trial (10.4 pounds) were considerably lower than the gains made by the hoggs in the 1953 trial (20.6 pounds). In the 1953 trial the gains made in both halves of the summer period were similar and the greater gain in the second half of the summer of this group of hoggs over those of the 1952 trial was sufficient to recoup the greater loss made during the winter. At first mating the average body weights of both hill wintered groups of hoggs were similar.

The hoggs which were away wintered made lower gains during the summer than those hoggs which were hill, inbye or inbye/away ½ wintered. In the first half of the summer the away wintered groups of the 1952 and 1953 trials

gained/

gained 15.8 pounds and 12.2 pounds respectively, while in the second half of the summer the gains were 2.2 pounds and 13.2 pounds respectively. Still noticeable was the similarity of the gains in the two halves of the summer of the 1953 trial and the reduced gain of the 1952 trial group in the second half of the summer. At first mating the difference in the average body weights of the two groups of hoggs similarly wintered was small. In both the 1952 and 1953 trials the hoggs which had been hill wintered were lighter at this stage than those hoggs which had been away wintered.

The groups of hoggs which were inbye wintered made summer gains remarkably similar to those which were hill wintered. The reduced gain of the hoggs of the 1952 trial in the second half of the summer was again apparent, but no great difference in body weight at first mating between the groups inbye wintered in 1952 and 1953 was observed. The body weight at first mating in 1953 resembled that of the hill wintered hoggs, while in 1952 the average body weight was midway between the hill and the away wintered groups.

The group of hoggs inbye wintered for half the winter in 1952 made summer gains similar to the hill and inbye wintered groups of that year. The group of hoggs which was away wintered for half the winter period of the 1953 trial made live weight gains during the summer similar to the gains made by the hill and inbye wintered groups of hoggs of the 1953 trial. Again the reduced gain in the second half of the summer of the 1952 trial was noticeable. The body weight at first mating of the inbye ½ wintered hoggs was similar to the inbye wintered group, but in the 1953 trial at first mating, the away ½ wintered group was heavier than the other three groups, although only heavier than the away wintered group by the difference in initial body weight of the groups.

The groups of hoggs which had been checked in growth during the wintering period/

period made greater gains during the summer than the groups of hoggs which had not received the check. The phenomenon of increased live weight gains after a check or store period is one which has been observed by many workers (Crichton et al., 1959; Brookes and Hodges, 1959; Bohman and Torell, 1956; Black et al., 1939; King, 1953), but nevertheless is one which has not been explained in physiological terms.

Callow (1947) has shown that as an animal matures, the energy content of the gain increases. As the away wintered groups of hoggs were heavier than the other groups at the beginning of the summer period, it would be expected that the gains made by this group would be of higher energy content and consequently, on similar food nutrient intake, would make smaller gains. Kleiber (1936) stated that the rate of production of body substances in growing animals depends on the stimulus for growth and on the level of available energy. Assuming that the wintering treatments did not significantly affect the capacity for herbage intake and the efficiency of digestion, the differences in live weight gains of the groups of hoggs made during the summer period (April - October) will reflect the composition of the gains and the growth stimulus. Preston and Gee (1957) have shown that when stimulating growth by oestrogens, the increased live weight gains were obtained by increasing muscular growth and reducing fat deposition, the energetic efficiency not being significantly affected. Thus it would appear that the stimulus for growth affected the composition of the gain. Helms and Bogart (1955) have shown that as an animal matures, more energy is required to lay down a pound of gain. This is controlled by the growth stimulus. Hansson (1956) pointed out from the results of his work that the flexibility of the rate of growth decreases as the animal grows older. If the growing capacity is exploited

in/

in the young animal by employing a high level of nutrition, this will be accompanied by a corresponding reduction in the growing capacity at subsequent stages. These findings were substantiated by the present data with reservation that in the groups of hoggs having received severe loss in body weight over a longer period of time during development, recovery did not appear to be as quick as their potential would suggest.

Taylor (1959) and Winchester and Howe (1954) have shown that retarded animals consume more feed daily than similar non-retarded animals when later fed an adequate ration. Although not considered in this study being reported, this factor cannot be ruled out as being totally or partially responsible for the increased summer gains of the groups which had been restricted.

The differences in summer gains made by the corresponding groups of the 1952 and 1953 trials may be due to the difference in composition of the gain and, as the weight at first mating appeared similar in both years, may be a function of the growth stimulus. However, it cannot be overlooked that the poorer gains of all the groups of hoggs in the second part of the summer period of the 1952 trial may have been due, at least in part, to a poorer plane of nutrition, although the maintained difference between the gains made by the away wintered hoggs and those of the other groups tended to suggest otherwise. In the absence of observations on the composition of the gain, no satisfactory explanation can be given.

The hoggs which received checks in growth during the winter period recovered during the summer months and at first mating were almost as heavy as those hoggs which had not been checked during the winter period. The group of hoggs which was away wintered until January before receiving a severe wintering check made as great body gains as those groups which had a more prolonged check. Because of the large gains made in the first part of the winter

by this group the overall gain from weaning to first mating was equal to that of the away wintered group of hoggs (35.2 pounds). Over the same period the hill and inbye wintered groups made gains of 29.5 and 31.0 pounds respectively. In the 1952 trial the inbye ½ wintered group of hoggs, while making summer gains (30.5 pounds) comparable with the hill and inbye wintered groups, did not make as great total gains from weaning to first mating as did the away wintered group (34.5 pounds) because of the poor gains made in the early part of the winter period. The gain from weaning to first mating of this group was, however, still equal to that of the inbye group (30.1 pounds) and superior to the gain made by the hill wintered group (25.3 pounds).

At first mating the body weight and body condition of the hoggs were affected by the wintering treatment even after the summer recovery period.

Heft x Wintering Interaction

During the wintering period the live weight response of the hoggs from the different hefts to the four wintering treatments was similar. Because the hefts were distinct breeding units as well as having distinct vegetation and location differences from each other, it was thought possible that hoggs from one heft might be better suited to one particular wintering method more than to another. The absence of any heft x wintering interaction would tend to suggest that hoggs from a wider range of conditions would respond similarly to these wintering methods.

When the hoggs were returned to the hill in April, it would be expected that heft differences in vegetation and location would be apparent. Although there were small heft differences, there was no indication, in the 1952 trial, of any interaction between the heft and the treatment. At the June recording in the 1953 trial, however, there was a significant heft x wintering interaction, indicating that, in the early part of the summer at least, hoggs from

some/

some hefts gave a greater response to certain winterings than to others. Hoggs from Boghall heft gave a reduced response to hill wintering and hoggs from West Park heft gave a reduced response to away wintering over this period. Hoggs from the Front heft gave a superior response to hill and away ½ wintering, while hoggs from the West Park gave a superior response to the inbye wintering. The interaction response disappeared by first mating. Further work is required to substantiate these findings, but the presence of the heft x wintering interaction in the early part of the summer period of only one trial and absence at all other times suggests that similar results could be obtained over a wider range of location and vegetation types than were vested in this study.

King et al. (1959) have also reported that for growth, wool production and carcase characters, breed and plane of nutrition difference was apparent, but there was an absence of genotype - environment interaction. This suggested that local breed adaptation was unlikely to be of major significance in respect of the characters studied.

The Effect of the Wintering Treatments on Mature Body Weight

In long term studies of growth in lactating animals, live weights and body measurements are complicated by pregnancy. The body weights of the ewes were taken annually six to eight weeks after the lambs were weaned.

The small differences in the average body weight at first mating of the groups of ewes which were hogg wintered differently disappeared after the first production year. Table LVI shows the means of the body weight of the groups of ewes taken annually in October. The body weight of the groups of ewes at maturity continued to increase with the increasing age of the ewes. The body weight of the hoggs that had been away wintered in both years and that of the hoggs away ½ wintered did not increase in body weight over the first

production/

production year, whereas all the other groups did so. It would appear that only the away and away ½ wintered groups were mature by first mating.

Table LVI. The mean body weight (lb. adjusted*) of the groups of ewes in the October of the production years and at first matings, having received four different hogg wintering treatments

	Hill		Away		Inbye		Inbye ½/Away ½	
	1952	1953	1952	1953	1952	1953	1952	1953
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
Oct. 1st Mating	95.0	96.8	102.7	100.7	98.7	16.3	99.8	104.2
Oct. 1st Prod. Yr.	104.4	99.7	102.0	99.7	104.2	98.4	105.1	104.0
Oct. 2nd Prod. Yr.	105.0	107.8	105.6	104.5	104.7	103.8	106.1	109.2
Oct. 3rd Prod. Yr.	111.5	121.3	112.2	120.2	110.6	118.4	115.3	125.9

* Adjustment for barren ewes (p. 22).

The Effect of the Wintering Treatments on the Skeletal Development

(a) Cannon Bone. Changes in live weight with age constitute a measurement of the rate of body development. However, when studying the influence of different levels of nutrition, the live weight is not a particularly accurate measurement of the stage of body development or of condition unless the size of the animals is similar. In this study the cannon bone has been used as a measure of the effect of the wintering treatments on early maturing skeletal parts. Table LVII gives the increase in cannon bone length over the wintering period.

Table LVII/

Table LVII. The mean increases in cannon bone length (cm.) over the wintering treatment period of the groups of hoggs (1952 trial) having received four different wintering treatments

	Hill	Away	Inbye	Inbye ½
Oct. 1 to Jan. 6	0.26	0.53	0.30	0.61
Jan. 6 to Apr. 1	0.19	0.76	0.57	0.02
Total Wintering Period	0.45	1.29	0.87	0.63

The cannon bone growth is arrested under periods of severe nutritional restriction. The correlation between the body weight changes during the winter and the changes in the length of the cannon bone was $r = 0.764$, which showed that only 58 per cent of the variation in the changes in the length of the cannon bone was related to the body weight changes. This may be partially explained by the fact that unlike body weight, pure bone measures do not readily show a reduction in length.

The increase in length of cannon bone during the summer recovery period after the wintering treatments is given in Table LVIII.

Table LVIII. The mean increase (cm.) in cannon bone length from April 1 to October 29 of the groups of hoggs (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Length on Oct. 29, 1953	19.16	19.58	19.70	19.50
Apr. 1 - June 22	0.58	0.21	0.41	0.54
Total Summer	0.76	0.21	0.51	0.74
Total Oct. 1952 - Oct. 1953	1.21	1.50	1.38	1.37

When the hoggs went on to the summer hill grazing, the groups that had made/

made little growth of cannon bone during the winter made large gains in the first half of the summer, while the away wintered group of hoggs, which had made comparatively large increments during the winter, made only small gains. However, the hill wintered group of hoggs did not make as great a gain in cannon bone length as the away wintered group did over the winter and summer periods. The correlation between winter gain and summer gain was $r = -0.985$, which showed that for the extremes of this experiment the summer gain in cannon bone length was strongly inversely related to the previous winter gain in length. There was also a strong correlation ($r = 0.989$) between the mean early summer live weight gain and the mean increase in the length of the cannon bone over this period.

The length of the cannon bone was taken after the second, third and fourth production years. Unfortunately it was not possible to record the length after the first production year. Between first mating and the second production year and subsequent years only minor increases in bone length took place. The hill wintered group of hoggs at first mating was still significantly shorter in hind cannon bone than the other three groups, but by the second production year, although the tendency still persisted, the differences were not significant. It appears that the growth impulse of this bone ended at about 12 months of age for the away wintered group of hoggs and 15 months of age for the other three groups.

(b) Pelvic Bone. The distance between the hook and pin bones has been used in this study to indicate the effect of the wintering on the development of the later maturing skeletal parts. Crichton et al. (1959) used width of hooks as a measure in dairy animals and found that their development was not complete at six years of age. The measure of the hook to the pin by calipers includes/

includes the cover of fat, wool and other tissues, and so condition does affect the determination of the mature length. Crichton et al. also suggest that the tuber coxae are secondary centres of ossification and are known to continue growing until they have become completely fused with the ileum.

Table LIX shows the effect of the winterings on the growth of the pelvic bones during the treatment period.

Table LIX. The mean changes in pelvic bone length (cm.) from October 1, 1952, to April 1, 1953, of the groups of Blackface hoggs (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Oct. 1 - Jan. 6	-0.05	0.80	0.50	0.50
Jan. 6 - Apr. 1	0.03	1.25	0.41	-0.03
Total Winter Change	-0.02	2.05	0.91	0.47

The winterings which restricted body weight had a similar effect in restricting the growth of the pelvic bone. The correlation between the body weight changes and the changes in pelvic bone was r = 0.899.

The growth of the pelvic bone during the summer period is given in Table LX.

Table LX. The mean changes in pelvic bone length (cm.) from April 1, 1953, to October 29, 1953, of the groups of Blackface hoggs (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Apr. 1 - June 22	0.98	0.27	0.47	0.84
June 22 - Oct. 29	1.10	0.73	0.98	0.98
Total Summer	2.08	1.00	1.45	1.82
Oct. 1, 1952 - Oct. 29, 1953	2.06	3.05	2.36	2.29

Table/

Table LX shows that the groups of hoggs which received the greatest body weight restriction during the winter made the greatest amount of pelvic growth over the early part of the summer. In the second part of the summer period the away wintered group of hoggs, although still the smallest gain amongst the groups, was only slightly behind them. This may have been due to the effect of the condition of the animal on the measure. The correlation between the live weight response in the first part of the summer and the pelvic bone increase was r = .984.

Over the winter and summer periods the away wintered group showed the largest gain in pelvic length, with the hill, inbye and inbye ½ groups of hoggs similar in total gain.

The pelvic measurement was taken after weaning in each production year, except the first, when the observation could not be made. After the second production year and subsequently, there were no noticeable differences between the pelvic measure of the groups of hoggs. From October, 1953, to October, 1955, the hill wintered group gained 0.89 centimetres, while the away, inbye and inbye ½ wintered groups gained 0.18, 0.49 and 0.68 centimetres. It appeared that the away wintered group had matured in pelvic length by first mating, October 1953, while the other groups matured in this measure at a later date than this (in this study not precisely defined), but before the end of the second production year.

The Effect of the Wintering Method on the Fleece Weight

In the hogg year the average fleece weight of the groups of hoggs was directly related to the wintering treatment. This is in agreement with the findings of Davies (1954) and Smith (1953). Several workers (Clanton et al., 1959; Daly and Carter, 1955; Coop, 1953; Slen and Whiting, 1952) have shown that winter food supplements fed to hoggs and ewes increased the fleece weights/

weights over those not supplemented.

It would appear from the high correlation ($r = .982$) found between the fleece weight and the weight gains during the winter that the major influence in causing the fleece weight differences between the groups was the level of nutrition. From the modern concept of growth and development it would be expected, from the examples of other tissue relationships, that wool growth is a result of interrelations between level of food and growth stimulation. Coop (1953) in New Zealand has demonstrated the existence of a marked seasonal rhythm in wool growth, having a maximum in midsummer and a minimum in mid-winter, when dry ewes were kept indoors on an even plane of nutrition. Nutrition, pregnancy and lactation all modify the rhythm, while temperature and humidity do not appear to do so. In reviewing the literature Coop (1953) stated that the confusing evidence as to whether or not growth of wool is at a constant rate throughout the year was due to the confounding of the seasonal fluctuations in level of nutrition. While the fundamental cause of the seasonal rhythm remains obscure, Wildman (1957) has demonstrated a photo-periodic regulatory mechanism. Fraser and Short (1960) reported that the involvement of the endocrine system in wool growth had been established. Ferguson (1958) reviewed the results of increasing the wool growth by injections of thyroxine. Slen and Connell (1958) showed that the administration of oestradiol intramuscularly caused a significant reduction in the average weight of clean wool and suggested that this was a result of lowered thyroid activity and adrenal cortical stimulation.

In the 1952 trial there were no noticeable differences between the average fleece weights of the groups of ewes which had received different hogg wintering treatments. In the 1953 trial, while the differences were not significant, there was a tendency for the fleece weights of the ewes which had been/

been hill and inbye hogg wintered to be lighter than the away and away ½ groups. The more severe weight losses during the hogg wintering period may have permanently affected the efficiency of wool production. Hugo (1958) found that all primary follicles were present at birth and, in Merino sheep, the number of secondary follicles increased up to four months of age. He found that a low level of nutrition did not affect the number of follicles and so deduced that the decrease in wool weight due to the low level of feeding must be caused by the production of shorter and thinner fibres. Burns (1953) has shown that new secondary follicles may be noted in skin sections of Blackface lambs up to twelve weeks and possibly up to seventeen weeks of age. If this is so, then it is unlikely that the hogg wintering treatments would affect the follicle population. Although the possibility of a permanent reduction in the efficiency of wool growth due to the action of stress on hormonal activity cannot be overlooked, the present data suggest that the effect is only of minor importance.

The Effect of the Wintering Treatments on Fertility

The Degree of Barrenness. In this study barrenness was defined as the failure of a ewe to produce a full term lamb. This included the failure to conceive, early embryonic deaths and early abortions.

In the 1952 trial there were no significant differences in the degree of barrenness between the groups of ewes that had been hogg wintered differently. In the 1953 trial the group of hoggs which were away wintered until January before returning to the hill had a significantly lower incidence of barrenness than the hoggs which were away wintered for the whole winter.

The average incidence of barrenness was similar in both trials (7.4 - 1952; 7.3 - 1953). In the 1952 trial, however, there was a significantly greater/

greater degree of barrenness in the first two production years than in the final two, while in the 1953 trial the incidence was consistently similar over the four production years.

Jones (1958) has shown that, at Glensaugh, ewes born from 1945 to 1951 had percentage incidence of ewes barren to the ram of 9, 8, 7 and 6 per cent respectively in their first, second, third and fourth production years. Season appeared to be the largest variable.

The away hogg wintered group of ewes was consistently above average in incidence of barrenness in the two trials, while the inbye hogg wintered group was consistently lower than average. The hill hogg wintered group had a lower incidence of barren ewes in the 1952 trial than in the 1953 trial. The group of ewes hogg wintered inbye until January had a higher than average incidence of barrenness, while the group of ewes wintered away till January had a lower than average incidence.

The effects of hogg wintering treatments on the degree of barrenness of the groups of ewes would, if present, be more obvious in the first production year. Davies (1954) showed that in the first year consistently high incidence of barrenness occurred in ewes wintered at particular centres where body weight gains were poorer than their contemporaries. This was not apparent in the study being reported, for the high and low gaining groups had similar degrees of barrenness, whereas the inbye hogg wintered group had similar weight losses over the winter period to the hill wintered group and yet varied widely in the degree of barrenness. Davies (1954) may have been reporting that other factors (such as mineral nutrients) were confounding the results. Philips et al. (1945) working with range sheep in Utah found that the fertility of the ewes was affected in the first production year by restricting hogg nutrition./

nutrition. It was suggested that the development of the reproductive tract had been retarded.

The Percentage of Twinning. No significant effect of the hogg wintering treatments on the percentage of ewes which during their production lifetime gave birth to twin lambs was noted. In both trials the incidence of twinning in the groups of ewes which were hill, away and inbye hogg wintered was remarkably similar, while the inbye ½ hogg wintered group fell below and the away ½ hogg wintered group fell above their respective trial averages.

In the 1952 trial there was a higher lifetime incidence of twinning (22.2 per cent) than the 1953 trial (16.85 per cent). This arose chiefly from the higher percentage of twinning in the first production year of the 1952 trial. Any effect of the hogg wintering treatments on the twinning percentage would be most clearly detected in the first production year. The condition of the ewe at mating exerts an influence on the number of ova shed. It would appear that the ewes coming to the ram at first mating in the 1952 trial were in better condition than the ewes of the 1953 trial at first mating. The twinning percentage in the first year of the 1952 trial would appear to reflect the hogg wintering treatments, whereas in the 1953 trial this was not apparent. However, as can be seen from the subsequent production years, there appears to be a compensatory mechanism working, so that groups which had a higher than average incidence of twinning in any one year had lower than average percentages in the following year.

There was a strong trend, substantiating the findings of Jones (1958), that as the ewes aged, there was an increase in the percentage of twinning. Jones (1958) also reported that in years when the ewes bearing their first lamb were underdeveloped, substandard lambing percentages occurred. In ewes

which/

which were outstandingly well grown in their first production year a high lambing percentage, 124 per cent, was recorded, but the ewes failed to maintain this level of fertility. Donald (1958) has pointed out the importance of condition of the ewe at mating time, for in the study reported by him, not only did the lightest ewes produce many twins and the heaviest many singles, but also different years with the same twinning rate occurred, although the mean ewe weights at mating were different. Fraser (1957) reviewed the work on the practice of flushing and concluded that the success of the practice was influenced more by the condition of the ewe than by the actual body weight. Foote et al. (1959) reported that for yearling ewes the way they grew out was more important in determining their ovulation rate than their nutrient supply at the time of breeding, at least for animals continued on the same level of feeding as that at which they were grown out.

Under the conditions of the trials restricting the growth of hoggs during the winter did not affect the twinning capacity of the ewes but tended to alter their distribution over the production lifetime.

The Effect of the Wintering Treatment on Lamb Production

(i) Correction for Sex and Twinning. In order to avoid the statistical complications arising from sex and twinning, corrections were worked out for converting lamb weights to the equivalent of male singles.

Simple additive factors were used within seasons. Table LXI, for the four years of the 1952 trial, and Table LXII, for the four years of the 1953 trial, show the adjustments that were made to the birth weight and the daily rate of gain to weaning observations of the lambs born other than single males.

Table LXI/

Table LXI. The means of the annual correction factors (lb.) used for adjusting observed lamb weights and gain to those of single male lambs of the groups of ewes (1952 trial) having received four different hogg wintering treatments

		Female Single	Male Twin	Female Twin
Birth Wt. (lb.)	1954	1.25	5.87	5.72
	1955	- 0.30	1.50	1.55
	1956	0.34	1.23	1.60
	1957	0.40	2.08	1.84
	Mean	0.42	2.67	2.68
Daily Live Wt. Gain Birth to Weaning	1954	0.005	0.076	- 0.026
	1955	- 0.022	0.024	0.048
	1956	0.010	0.033	0.021
	1957	0.032	0.079	0.090
	Mean	0.006	0.053	0.033

Table LXII. The means of the annual correction factors (lb.) used for adjusting observed lamb weights and gain to those of single male lambs of the groups of ewes (1953 trial) having received four different hogg wintering treatments

		Female Single	Male Twin	Female Twin
Birth Wt. (lb.)	1955	0.10	-	3.21
	1956	0.63	0.91	1.89
	1957	0.05	1.50	2.33
	1958	- 0.29	2.56	1.85
	Mean	0.12	1.24	2.32
Daily Live Wt. Gain Birth to Weaning	1955	- 0.019	-	-
	1956	0.006	0.010	0.096
	1957	0.036	0.023	0.089
	1958	0.008	0.039	0.093
	Mean	0.008	0.039	0.093

The influence of sex and type of birth on lamb weights varied from year to year. This has been noted by McLean (1952), Donald (1958) and Donald and Purser (1956). In the study being reported the smallness of the subgroups may/

may have contributed to this variation. It would have been more accurate to use adjustment factors for each treatment group within years, but the smallness of each subgroup made this impracticable.

Apart from the large adjustment to be made for the twin lambs born to the maiden ewes (1954), the adjustment appeared to be within the ranges given by Donald (1958) for aged Blackface ewes rearing cross-bred lambs. No adjustment was made for the date of lambing. Only negligible correlations were found for date of lambing and birth weight and for date of lambing and gain to weaning. Several workers have reported that birth weights increased as lambing proceeded (Hammond, 1932; Donald and McLean, 1935; McLean, 1952; Jones, 1958). However, Donald (1958) showed that under hill grazing conditions (1,000 feet) they increased significantly only once in five years.

(ii) Birth Weight. The birth weight was taken as an indication of the strength of the lamb at birth. Several workers (Purser and Roberts, 1953; Gill and Thompson, 1954; Purser and Young, 1959) have shown that the weight of the lamb at birth does influence the chance of survival.

Over the lifetime of the groups of ewes of both trials no noticeable differences occurred in the birth weight of the lambs due to the hogg wintering treatments. However, in the first production year certain treatment differences were apparent. In the 1952 trial the average birth weight of the lambs born to the group of ewes away hogg wintered was 0.8 pounds heavier than lambs from ewes of the other three groups. This difference was not significant, however, when tested. In the 1953 trial the away ½ hogg wintered group of ewes gave birth to lambs in the first production year significantly ($P < .05$) heavier (0.85 pounds) than those born to the hill hogg wintered group of ewes. Many workers (Clanton et al., 1959; Slen and Whiting, 1952 b) have found/

found that supplementing ewes during the winter period produced lambs heavier at birth than ewes not supplemented. Gill and Thompson (1954) found that, with ewes on the same pre-lambing level of feeding, body development and condition was an influence on the weight of the lamb at birth. Jones (1958) showed that in ewes lambing at two years of age for the first time, the development and condition of the ewe influenced the weight of the lamb at birth.

Taking the weight of the lamb at birth as an indicator of the condition of the ewe during gestation, then it would appear that the away hogg wintered group of ewes in the 1952 trial and the away $\frac{1}{2}$ hogg wintered group of ewes in the 1953 trial were in better condition than their contemporaries.

Apart from the exception of the first production year of the 1952 trial, the data agree with Jones (1954) and Starke et al. (1958), who reported an improvement of birth weight of the lambs as the ewes aged.

In the final production year of the 1952 trial the hill and inbye $\frac{1}{2}$ hogg wintered groups of ewes gave birth to significantly ($P < .05$) heavier lambs than the ewes of the other two groups. It cannot be told from these data whether this reflected a difference in wearing ability of the ewes as a result of these hogg wintering treatments. No such difference appeared in the final year of the 1953 trial.

(iii) Rate of Gain to Weaning. The rate of gain to weaning of the lambs from the groups of ewes was taken as an indication of the effect of the hogg wintering treatments on the nursing capacity of the ewe. In the 1952 trial no noticeable differences occurred in the rate of gain from birth to weaning of lambs from the groups of ewes having received different hogg wintering treatments. Doney (1955) showed that under hill conditions the growth curve in August and September was almost flat and young lambs and slow growing lambs have/

have made up for their late start. Any effect the hogg wintering treatments may have had, on both pre-natal and post-natal growth of the lambs, appeared to have been compensated for by weaning time.

In the 1953 trial, however, the hogg wintering treatments did affect the growth rate of the lambs born to the ewes. In the lifetime averages the growth rate of the lambs from the hill and inbye wintered groups was significantly ($P<.05$) lower than that of lambs from the other two groups. In the first production year lambs born to the hill hogg wintered group of ewes had a significantly ($P<.01$) lower growth rate than lambs of any of the other three groups. The severe loss in weight in the hill hogg wintering treatment in the 1953 trial was sufficient to cause a reduction in the weight of the lamb at weaning. The lighter weight of the lamb at birth and the lowered growth rate in the first production year would suggest that ewes of this group were immature at first mating. Although there was partial recovery in the later production years, there remained a tendency for the ewes of this group to produce lambs with a lower than average growth rate throughout their production lifetime.

Holl (1959), studying the effect of age at first mating, has shown that with dairy cattle, delaying mating until 27 months the cows gave a significantly greater yield over three lactations than those mated at 18 months. The apparent immaturity of the hill hogg wintered ewes at first mating may have prevented the full expression of milk production. Body weight was increased at the expense of the milk production. It is recognised also that an excessively high rearing intensity depresses milk yield (Hansson, 1956; Swanson and Spann, 1954). No significant indication was given in either trial that this point had been reached in any of the treatments, but the away wintered group of ewes in the 1952 trial having made the greatest gains

during/

during development, produced lambs having the slowest growth rate.

There was an obvious tendency in both trials for the growth rate of the lambs to improve with the age of the ewe. This was noted by Jones (1958).

The Length of the Production Lifetime of the Ewes

The number of production years a ewe stays in the flock is an economically important factor in sheep farming. Although in neither trial was there shown to be significant differences between the differently hogg wintered groups of ewes in the percentage of production years, the mean percentages revealed that the hill hogg wintered group in the 1952 trial and the hill and inbye hogg wintered groups of ewes in the 1953 trial had lower than average percentages.

Ewes were lost to production on death, bad udder, inability to rear a lamb satisfactorily, pining and other debilitating troubles. However, culling was only undertaken when it was absolutely necessary. Certain hefts were affected more than others and in the hill hogg wintered group the ewes from the Howgate heft responded very poorly to the hill wintering regime in the 1952 trial. As the hogg wintering practice up to 1952 had been to away winter the hoggs, no selection for the hill wintering regime had been practised.

GENERAL DISCUSSION

The results of this study emphasise that the live weight response made by hoggs to a particular winter grazing regime varies widely from year to year. This indicated the need to evaluate the wintering methods over a number of years which would include the extremes in climatic conditions.

The live weight of hoggs wintered on a total grassland diet reflects closely the quality and quantity of the herbage available to them. Hoggs grazing on the natural hill herbage in winter would be expected to lose weight because of the quality of the foggage and the lack of new herbage growth in spring. In this study losses of 7.1 and 13.1 pounds were recorded in 1952 and 1953 respectively. Hoggs wintered on good lowground pasture in winter could be expected to gain in body weight because the quality of the herbage available is good and the location such that late autumn and early spring growth of grass may occur. Gains of 16.6 pounds and 9.7 pounds were made in the 1952 and 1953 trials respectively and correspond with those reported in the literature. Live weight gains of hoggs wintered on improved inbye fields would be expected to be intermediate between the hill and lowground wintered groups. Although the quality of the herbage available to the hoggs could be good, the high elevation would tend to reduce any late autumn and early spring growth. In the trials being reported hoggs wintered on inbye fields gained 0.4 pounds in body weight in 1952 and lost 12.5 pounds in body weight in 1953.

As the results were obtained at only one location, general application would be unwise, but as Castlelaw Hill is similar to large areas of the Southern Uplands of Scotland and as there was almost complete absence of heft x wintering interactions, it would seem that the results may have wider application/

application than to those conditions under which the study was conducted.

Since it has been shown that the wintering treatment was greatly affected by the year, then it is more informative to regard the wintering treatments as levels of nutrition and to compare the hoggs which had been well grown over this period to those that had been heavily restricted. The assumption has to be made that body weight gains produced under different grazing conditions are similar in composition.

Restricted v. Unrestricted Growth during Hogg Wintering Period

The groups of hoggs which were most severely restricted in body weight growth during the wintering period were the hill wintered groups in the 1952 and 1953 trials and the inbye wintered group of the 1953 trial. Loss of body weight was 7.1, 13.1 and 12.5 pounds respectively. The groups of hoggs which made the greatest gain during the winter period were the groups which were away wintered in 1952 and 1953 and the group which was inbye wintered in 1952. The gain in body weight was 16.6, 9.7 and 0.4 pounds respectively.

Restricting growth during the hogg wintering period made the weight of the hoggs at first mating approximately 4 pounds lighter than those which had made growth during this period. By the October of the first production year this difference had disappeared. The mature skeletal size was not affected by the restriction of growth during the hogg wintering period.

In the hoggs which had been restricted in growth during the winter period wool production was reduced by approximately 1.5 pounds per fleece in the hogg year. In subsequent production years the differences in fleece weight of the ewes having received different hogg wintering treatments were not significant, but there was a tendency for the fleece weight of the ewes having received the most restrictive hogg wintering treatments to be slightly lighter than their contemporaries.

Under/

Under the conditions of the two trials, restricting the growth of hoggs during the hogg wintering period did not appear to affect the incidence of barrenness of the ewes significantly, there being a slight tendency for the ewes which had not received a check in growth during the hogg wintering period to have a greater incidence of barrenness.

The average lifetime incidence of twinning was not affected by the method of hogg wintering, although in the first production year of the ewes of the 1952 trial differences in twinning percentages were noticed between the groups having been hogg wintered differently. This was not repeated in the 1953 trial and may have been due to the fact that in general the first production year of the 1953 trial produced very few twins. However, the high lambing percentages in the unrestricted hogg wintered groups of ewes in the 1952 trial were not sustained in subsequent production years and high and low incidences of twinning were balanced out over the productive lifetime.

The restriction in the growth of the hoggs did not affect the birth weight of the lambs from the groups of ewes averaged over their lifetime. However, in the first production year of the 1952 trial the lambs from the away hogg wintered groups of ewes were slightly heavier than lambs from the ewes of the other three groups and in the 1953 trial lambs born to the groups of ewes which were hill wintered were slightly lighter than those born to the away and inbye wintered groups. None of these differences reached significance ($P < .05$).

In the 1952 trial the growth rate of the lambs was not affected by the method of hogg wintering, but in the 1953 trial the lambs from ewes which had been restricted in growth as hoggs were on average 2 - 2½ pounds lighter than lambs from ewes which had not been restricted in growth during the hogg wintering/

wintering period. In the first production year of the 1953 trial the growth rate of lambs from the hill hogg wintered ewes was significantly ($P < .01$) lower than that of lambs from the other three groups of ewes.

Regarding the number of production years the ewes remained in the flock, there appeared to be a tendency for the groups of ewes which had had uninterrupted growth as hoggs to have a higher percentage of production years than those groups which had received a check during development. This was not significant, however.

The production characters studied were not seriously affected by restricting the growth of the hoggs during the first winter. It was apparent that average body weight losses of 13 pounds over this period were approaching the level when the production of the ewes could be permanently damaged. Groups receiving smaller body weight losses during the hogg wintering period did have a tendency to lowered production in the first year, but this was compensated for in subsequent years. There are obvious dangers of misinterpretation if the assessment of the effects on production of the hogg wintering treatments is based on the results of the first production year alone.

The Return of the Ewes to the Hill in January

In an attempt to overcome the reported loss in fertility associated with a check in growth and yet to gain the economics of a shorter "off the hill" wintering period, the inbye $\frac{1}{2}$ and the away $\frac{1}{2}$ wintering treatments were included. Returning the ewes to the hill in January produced a greater live weight loss than hoggs kept on the hill the whole winter. Summer gains were similar to the more prolonged restricted groups. In the 1952 trial, when the gain during inbye wintering from October to January was only 4.8 pounds, fertility appeared to be affected. Barrenness in this group of ewes was particularly high in the first production year and the incidence of twinning (11.1 per cent) in the

Cont./

first production year, although superior to the hill wintered groups (4.0 per cent) was lower than the away (29.6 per cent) and inbye (18.5 per cent) wintered groups. The hill wintered group of ewes recovered in twinning percentage in subsequent years to reach a lifetime average twinning percentage similar to the away and inbye wintered groups, whereas the inbye ½ wintered group did not.

The away ½ wintered group of hoggs gained 14.8 pounds from October to January and after the summer recovery period, had made live weight gains equal to the group of hoggs away wintered for the whole winter period. This group of ewes had a significantly ($P < .05$) lower incidence of barrenness than the away hogg wintered group of ewes and a higher twinning percentage than the other three groups. This interesting result is being further investigated in trials which started in 1958, 1959 and 1960 and the technique has been used with success commercially on a neighbouring hill since 1958. The technique has proved particularly suitable because of no loss in production compared with the traditional practice of away wintering and because it meets the dairy farmer's requirement of being able to fertilise and lock up the grazing in February for the early bite. However, these results indicate that the success of the practice depends upon the ability of the grazing to afford good live weight gains up to the time the hoggs return to the hill.

CONCLUSIONS

1. The study confirmed the findings of Davies (1954) that the live weight responses of hoggs to various wintering practices differed from year to year. This finding pointed to the necessity of evaluating the effects of wintering practices over the extremes of climatic conditions.

In the 1952 and 1953 trials respectively the hill wintered groups of hoggs lost 7.1 and 13.1 pounds body weight, while those away wintered gained 16.6 and 9.7 pounds. The other two methods were intermediate. It is recognised that the live weight gains made by the groups are dependent upon the quality and quantity of herbage available during the period and this in turn is related to the type of sward, management of the sward, location and weather. These factors interact to cause variation between years and between the wintering methods.

2. As the trials were conducted over only two years and at one location, it appeared to be more appropriate to characterise the hogg winterings by the body weight changes occurring over that period. This did not consider differences in body composition which may have resulted from differences in the wintering methods. Evidence from the literature indicated that live weight gain and the energy content of the body tissues may be affected by the composition of the ration and the previous nutritional regime.

3. Under the conditions of the trials, hoggs hill wintered can be expected to lose body weight. In this trial losses of 7.1 and 13.1 pounds were recorded. Hoggs away wintered can be expected to make substantial live weight gains and in the trial being reported gains of 16.6 and 9.7 pounds were made. Hoggs wintered inbye would be expected to make live weight gains intermediate between the hill and away wintering methods. In the 1952 trial this

was/

was so, but in the 1953 trial inbye wintering was little better than hill wintering. At high altitudes herbage growth during the wintering period is unlikely and makes wintering on improved inbye swards dependent upon foggage.

4. The live weight gains made during the summer period following the hogg wintering were strongly negatively correlated with the live weight gains made during the wintering period. Correlations between the gains of the winter period and those of the early summer were found to be for 1952 $r = -0.964$; and for 1953 $r = -0.955$. The greatest summer gain was 43.5 pounds and the smallest 18.0 pounds. Despite the ability of the groups which had been restricted in growth during the winter to make greater weight gains in the summer period, the groups of hoggs which were restricted during the winter were still not as heavy as their unrestricted contemporaries by first mating. However, by the time of the second pregnancy any differences that occurred at first mating had disappeared.

5. The wintering treatments affected the rate of gain to maturity, but mature body weight and mature skeletal size were not found to be significantly affected. Skeletal development followed a similar pattern of development to body weight prior to maturity ($r = 0.989$ for cannon; $r = 0.899$ for pelvis length). Neither the early maturing bone studied or the late maturing bone gave any indication of being permanently affected by the periods of restricted growth.

6. The fleece weight of the hoggs was closely associated with the wintering treatment ($r = 0.982$). In subsequent years of the 1952 trial there were no noticeable differences in the average fleece weights of the groups of ewes which had been wintered differently, but in the 1953 trial, when the weight losses of the hill and inbye wintered hoggs were 13.1 and 12.5 pounds respectively, there was a tendency for the average fleece weights of these two

groups/

groups to be lower than those of the away and away ½ wintered groups.

7. Restricting the growth of hoggs during the wintering period did not appear to affect significantly the incidence of barrenness of the ewes either in the first production year or in subsequeht years. Regarding the twinning percentage, in the first production year of the 1952 trial the twinning percentage improved with the increase in gains made during the hogg wintering period. However, compensations occurred in subsequent years to make the average lifetime incidence of twinning of the hill, away and inbye wintered groups similar. In the 1953 trial the twinning percentage was not affected, either in the first production year or in the average lifetime incidence, by restricting the growth of the hoggs during the hogg wintering period.

8. The average birth weight of the lambs born to the groups of ewes was not found to be significantly affected by restricting hogg growth. However, there was a tendency for the ewes which were more mature at first pregnancy to have slightly heavier lambs in the first production year.

9. In the 1952 trial the rate of gain of the lambs from birth to weaning was not affected by the hogg wintering method. However, in the 1953 trial when the hill wintered groups of hoggs lost 13.1 pounds live weight over the winter period, the growth rate of the lambs from this group was significantly ($P < .05$) lower than lambs from the away wintered group. Over the lifetime of the ewes the lambs from the hill hogg wintered group averaged 2.5 pounds lighter in body weight at 100 days of age than did those from the away hogg wintered group.

10. Although the number of years the ewes remained in the flock tended to be lower for hill wintered groups of ewes than for the away and inbye wintered groups, this difference did not reach significance in either trial.

11. The groups of hoggs which were returned to the hill in January responded/

responded differently in the two trials. In the 1952 trial when the live weight gain made before returning to the hill was small (4.8 pounds), fertility tended to be adversely affected, as indicated by the greatest incidence of barrenness and the lowest twinning percentage. The other characters studied appeared to be unaffected. In contrast in the 1953 trial, when the gain made from October to January was 14.8 pounds, fertility tended to be improved, as indicated by the group having the lowest incidence of barrenness and the greatest twinning percentage. Further study is being made to substantiate this observation.

12. As the ewes aged, an increase in body weight, an increase in twinning percentage, and an increase in the birth weight and growth rate of the lambs was observed. This would explain why the influence of the hogg wintering practices was not so apparent after the first production year. Practices which cause the ewes to reach first mating immature can be expected to affect fertility and lamb production in the first year noticeably. In subsequent years there appeared to be, under the conditions of both trials, satisfactory opportunity to make up on any deficiencies. However, if the hogg wintering practice was too severe, then permanent damage to production factors would result. It would seem that under Castlelaw conditions losses of 19 per cent of the initial body weight over the hogg wintering period were approaching this point.

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APPENDIX

APPENDIX TABLE 1

The means of body weights (lb.) recorded throughout their lives of the groups of B.F. hoggs (1952 trial) given four different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½	Overall
Initial wt.	1/10/52	69.7	68.1	68.6	69.3	68.9
3 months	6/1/53	63.3	71.7	72.8	74.1	70.5
6 "	1/4/53	62.6	84.7	69.0	65.1	70.4
9 "	22/6/53	84.6	100.5	87.5	85.6	89.6
13 "	29/10/53	95.0	102.7	98.7	99.8	99.1
18 "	9/4/54	84.6	89.6	86.2	84.4	
24 "	6/10/54	104.4	102.0	104.2	105.1	
36 "	1/10/55	105.0	105.6	104.7	106.1	
48 "	2/10/56	111.5	112.2	110.6	115.3	
59½ "	12/9/57	111.6	115.2	119.1	119.8	

APPENDIX TABLE 2

The body weight (lb.) of hoggs of the 1952 trial on Oct. 1 at the start of the hoggs wintering treatments

		Hill	Away	Inbye	Inbye ½
Boghall		73	70	58	61
		62	59	58	73
		66	60	69	56
		75	68	64	71
		73	68	85	62
		58	68	67	62
		67	67	61	68
	Heft Total	474	460	462	453
	" Mean	67.7	65.7	66.0	64.7
Howgate		74	68	64	85
		66	61	57	56
		67	66	67	70
		68	70	74	76
		60	65	77	54
		68	79	62	64
		52	58	63	68
	Heft Total	455	467	464	473
	" Mean	65.0	66.7	66.3	67.6
Front		68	60	64	70
		80	74	68	76
		77	61	63	73
		71	77	72	66
		79	78	78	73
		66	64	79	73
		65	60	66	66
	Heft Total	506	474	490	497
	" Mean	72.3	67.7	70.0	70.1
West Park		63	66	69	73
		93	88	75	83
		73	75	71	69
		83	61	66	68
		68	71	80	81
		71	68	75	77
		67	77	69	68
	Heft Total	518	506	505	519
	" Mean	74.0	72.3	72.1	74.1
Tmt. Total		1,953	1,907	1,921	1,942
Tmt. Mean		69.7	68.1	68.6	69.3

APPENDIX TABLE 2(a)

The analysis of variance of the body weight (lb.) of hoggs of the 1952 trial on Oct. 1, at the start of the hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	111	6,291				
Between Total Tmts.	15	1,116	74.4	1.38	1.75	2.19
Winterings	3	45	15	1.25	3.86	6.99
Hefts	3	961	320	26.60**		
Heft x Wintering	9	110	12	-		
Within Tmts.	96	5,175	53.9			

** Significant at $P < .01$.

APPENDIX TABLE 3

The body weight (lb.) of hoggs of the 1952 trial on Jan. 8, 1953 midway through the wintering treatments

		Hill	Away	Inbye	Inbye ½
Boghall		66	74	60	66
		61	64	71	69
		60	65	74	57
		72	70	74	73
		67	74	90	72
		55	71	78	69
		64	72	66	74
	Heft Total	445	490	513	480
	" Mean	63.6	70.0	73.3	68.6
Howgate		69	71	68	93
		61	66	60	59
		57	71	73	78
		60	76	77	83
		58	74	85	62
		61	81	63	76
		46	64	65	74
	Heft Total	412	503	491	525
	" Mean	58.8	71.9	70.1	75.0
Front		64	69	69	76
		66	76	67	81
		69	62	52	81
		66	83	71	64
		70	74	82	74
		57	72	84	76
		63	65	67	73
	Heft Total	455	501	492	525
	" Mean	65.0	71.6	70.3	75.0
West Park		51	65	74	78
		77	86	98	82
		66	77	72	71
		75	64	64	69
		65	76	85	81
		65	70	75	85
		61	76	74	78
	Heft Total	460	514	542	544
	" Mean	65.7	73.4	74.4	77.7
Tmt. Total		1,772	2,008	2,038	2,074
Tmt. Mean		63.3	71.7	72.8	74.1

APPENDIX TABLE 3(a)

The analysis of variance of the body weight (lb.) of hogs of the 1952 trial on Jan. 8, 1953, midway through the wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	111	8,540				
Between Total Tmts.	15	2,801				
Winterings	3	2,001	667.0	15.3**	3.86	6.99
Hefts	3	406	135.3	3.1		
Heft x Wintering	9	394	43.7			
Within Tmts.	96	5,739	59.8			
Comparisons:						
Winterings	3	2,001	667.0	15.3	3.86	6.99
Hill v. Rest	1	1,924	1,924	44.0**	5.12	10.56
Remainder	2	77	38			
Hefts	3	406	135.3	3.1	3.86	6.99
Boghall & Howgate v. Front & West Park	1	270	270	6.2*	5.12	10.56
Remainder	2	136	68	1.5	4.26	8.02

** Significant at $P < .01$.
* Significant at $P < .05$.

APPENDIX TABLE 4

The body weight (lb.) of hoggs of the 1952 trial on April 1, 1953 at the end of the wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	65	93	58	63
	58	79	70	61
	55	76	72	53
	72	84	70	69
	66	82	81	68
	51	84	74	51
	62	79	67	64
Heft Total	429	577	492	429
" Mean	61.3	82.4	70.3	61.3
Howgate	73	83	61	86
	65	84	62	58
	58	82	66	73
	63	86	75	74
	55	91	73	55
	57	96	60	64
	40	79	65	64
Heft Total	411	601	462	474
" Mean	58.7	85.9	66.0	67.7
Front	60	81	64	66
	92	82	61	69
	60	64	58	67
	67	84	69	63
	73	86	74	67
	59	87	76	67
	68	84	65	63
Heft Total	479	568	467	462
" Mean	68.4	81.1	66.7	66.0
West Park	45	77	76	68
	71	103	72	75
	67	100	67	56
	66	72	67	51
	63	96	83	75
	58	84	70	71
	65	93	76	61
Heft Total	435	625	511	457
" Mean	62.1	89.3	73.0	65.3
Tmt. Total	1,754	2,371	1,932	1,822
Tmt. Mean	62.6	84.7	69.0	65.1

APPENDIX TABLE 4(a)

The analysis of variance of the body weight (lb.) of hoggs of the 1952 trial on April 1, 1953, at the end of the wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	111	15,476				
Between Total Tmts.	15	9,235				
Winterings	3	8,243	2,747	30.6**	3.86	6.99
Hefts	3	205	68.3			
Heft x Wintering	9	807	89.7			
Within Tmts.	96	6,221	64.8			
Comparisons:						
Winterings						
Hill v. Rest	1	2,216	2,216	24.7**	5.12	10.56
Away v. Rest	1	7,667	7,667	85.4**	5.12	10.56
Away v. Inbye	1	3,442	3,442	38.4**	5.12	10.56
Hill v. Inbye	1	565	565	6.3*	5.12	10.56
Hill v. Inbye ½	1	82	82	-	-	-
Inbye v. Inbye ½	1	216	216	2.4	5.12	10.56

** Significant at P<.01.
* Significant at P<.05.

APPENDIX TABLE 5

The body weight (lb.) of hoggs of the 1952 trial on June 22, 1953 after having received four wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	91	107	82	87
	74	100	76	75
	77	93	79	64
	95	97	77	71
	89	97	90	85
	77	98	78	75
	91	97	77	88
Heft Total	594	689	559	545
" Mean	84.8	98.4	79.9	77.8
Howgate	97	96	81	110
	94	98	79	78
	80	105	84	93
	93	107	95	106
	73	109	101	73
	78	110	79	85
	62	93	74	88
Heft Total	577	718	593	633
" Mean	82.4	102.6	84.7	90.4
Front	82	99	85	86
	78	105	84	87
	83	78	79	65
	82	104	99	85
	80	100	98	93
	84	105	108	94
	81	98	85	82
Heft Total	570	689	638	592
" Mean	81.4	98.4	91.1	84.6
West Park	75	85	96	91
	103	115	92	99
	85	117	90	86
	104	82	88	73
	82	108	102	94
	96	98	94	93
	84	114	99	90
Heft Total	629	719	661	626
" Mean	89.8	102.7	94.4	89.4
Tmt. Total	2,370	2,815	2,451	2,396
Tmt. Mean	84.6	100.5	87.5	85.6

APPENDIX TABLE 5(a)

The analysis of variance of the body weight (lb.) of hogs of the 1952 trial on June 22, 1953, after having received four wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	111	14,867				
Between Total Tmts.	15	6,615				
Winterings	3	4,610	1,536.6	15.6 **	3.86	6.99
Hefts	3	1,118	372.6	3.78		
Heft x Wintering	9	887	98.5	1.15	1.97	2.59
Within Tmts.	96	8,252	85.95			
Comparisons:						
Winterings						
Away v. Rest	1	4,488	4,483	45.5 **	5.12	10.56
Away v. Inbye	1	2,366	2,366	24.0 **	5.12	10.56
Hill v. Inbye	1	117	117	1.18	5.12	10.56
Hefts						
Boghall & Howgate v. Front & West Park	1	417	417	4.23	5.12	10.56

** Significant at $P < .01$.

APPENDIX TABLE 6

The body weight (lb.) of hoggs of the 1952 trial on Oct. 29, 1953 after having received four wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	104	117	92	96
	84	100	96	89
	83	93	92	77
	92	97	90	104
	93	97	112	96
	82	98	92	82
	98	97	94	94
Heft Total	636	689	668	638
" Mean	90.9	98.4	95.4	91.1
Howgate	105	89	87	116
	97	112	88	86
	80	111	103	105
	102	115	99	116
	84	107	116	84
	82	102	82	98
	70	91	83	94
Heft Total	620	727	658	699
" Mean	88.7	103.9	94.0	99.9
Front	96	103	101	106
	92	106	97	96
	105	86	92	100
	96	96	112	103
	84	96	115	110
	97	110	126	106
	96	96	81	92
Heft Total	666	693	724	713
" Mean	95.1	99.0	103.4	101.9
West Park	94	88	101	111
	122	126	102	118
	102	122	103	102
	113	88	90	94
	92	103	108	115
	116	103	100	110
	99	114	109	96
Heft Total	738	744	713	746
" Mean	105.4	106.3	101.9	106.6
Tmt. Total	2,660	2,876	2,763	2,796
Tmt. Mean	95.0	102.7	98.7	99.8

APPENDIX TABLE 6(a)

The analysis of variance of the body weight (lb.) of hogs of the 1952 trial on Oct. 29, 1953, after having received four wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	111	10,875				
Between Total Tmts.	15	3,562				
Winterings	3	857	286	2.57	3.86	6.99
Hefts	3	1,703	567	5.10**	3.86	6.99
Heft x Wintering	9	1,002	111	1.46	1.97	2.59
Within Tmts.	96	7,313	76.2			
Comparisons:						
Winterings						
Away v. Rest	1	498	498	4.48	5.12	10.56
Away v. Hill	1	833	833	7.50*	5.12	10.56
Hill v. Inb/e ½	1	330	330	3.0	5.12	10.56
Hefts						
Boghall & Howgate v. Front & West Park	1	1,283	1,283	11.56**	5.12	10.56

** Significant at $P < .05$.
* Significant at $P < .01$.

APPENDIX TABLE 7

The body weight (lb.) of hoggs of the 1952 trial on April 9, 1954 (approx. 23 mths. of age) after receiving different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½
Boghall		104	102	82	82
		72	94	89	78
		-	97	85	-
		86	92	84	84
		86	102	90	88
		72	89	80	77
		101	90	90	85
	Heft Total	521	666	600	494
	" Mean	86.8	95.1	85.7	82.3
Howgate		94	81	72	100
		82	100	74	68
		70	94	95	75
		94	95	84	92
		72	80	82	74
		70	90	67	88
		-	67	74	85
	Heft Total	482	607	548	582
	" Mean	80.3	86.7	78.3	83.1
Front		86	90	92	91
		78	90	82	65
		92	76	80	89
		-	80	96	92
		76	-	100	96
		82	87	99	92
		88	87	-	82
	Heft Total	502	520	549	607
	" Mean	83.8	86.7	91.5	86.7
West Park		77	70	87	90
		107	99	84	97
		89	112	90	81
		96	72	90	68
		80	85	90	95
		91	93	94	84
		71	96	97	81
	Heft Total	611	627	632	596
	" Mean	87.3	89.6	90.3	85.1
Tmt. Total		2,116	2,420	2,329	2,279
Tmt. Mean		84.6	89.6	86.2	84.4

APPENDIX TABLE 7(a)

The analysis of variance of the body weight (lb.) of hoggs of the 1952 trial on April 2, 1954 (approx. 23 mths. of age), after receiving different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	105	9,247				
Between Winterings	3	465	155.0	1.80	2.70	3.98
Within Winterings	102	8,782	86.1			

APPENDIX TABLE 8

The body weight (lb.) of the four groups of ewes of the 1952 trial on Oct. 6, 1954 (approx. 30 mths. of age) after having received different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½
Boghall		120	106	101	101
		-	95	114	88
		-	95	107	-
		106	89	94	120
		100	93	116	91
		76	96	93	-
		116	103	103	106
	Heft Total	518	677	726	506
	" Mean	103.2	96.7	104.0	101.2
Howgate		117	87	-	105
		107	100	-	91
		100	111	108	105
		107	117	101	122
		-	91	118	81
		-	93	84	96
		-	88	81	106
	Heft Total	431	685	492	706
	" Mean	107.8	97.9	98.4	100.9
Front		105	108	109	110
		101	114	101	103
		93	93	92	-
		-	130	117	105
		101	-	117	112
		104	109	110	111
		97	86	-	97
	Heft Total	601	640	646	638
	" Mean	100.2	106.7	107.7	106.3
West Park		-	-	97	106
		111	115	116	124
		104	115	125	108
		115	94	90	103
		102	102	108	105
		116	105	100	119
		95	118	104	113
	Heft Total	643	649	740	778
	" Mean	107.1	108.2	105.7	111.1
Tmt. Total		2,193	2,651	2,606	2,628
Tmt. Mean		101.4	102.0	104.2	105.1
No. Observations		21	26	25	25

APPENDIX TABLE 8(a)

The analysis of variance of the body weight (lb.) of the four groups of ewes of the 1952 trial on Oct. 6, 1954 (approx. 30 mths. of age) having received four different hoof wintering treatments

Source	d.f.	s.s.	m.s.	F
Total	96	11,071		
Between Winterings	3	143	47.7	-
Within Winterings	93	10,928	117.5	-

APPENDIX TABLE 9

The body weight (lb.) on Oct. 1, 1955 (approx. 42 mths. of age) of the groups of ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
	110	111	103	98
	-	111	100	110
	-	108	111	-
Boghall	107	103	96	113
	111	101	109	101
	92	110	108	-
	100	123	104	105
Heft Total	520	767	731	527
" Mean	104	109.6	104.4	105.4
	100	88	-	-
	109	91	-	-
	110	110	84	88
Howgate	111	124	113	119
	-	91	112	99
	-	-	100	104
	-	80	94	105
Heft Total	430	584	503	515
" Mean	107.5	97.3	100.6	103.0
	98	100	108	116
	102	108	-	100
	98	98	88	-
Front	-	117	116	106
	100	-	105	104
	98	111	114	114
	92	97	-	108
Heft Total	588	631	531	648
" Mean	98.0	105.2	106.2	108.0
	-	-	109	112
	123	105	122	101
	100	115	105	98
West Park	110	104	98	104
	-	113	104	110
	131	110	104	115
	98	111	106	111
Heft Total	562	658	748	751
" Mean	112.4	109.7	106.8	107.3
Tmt. Total	2,100	2,640	2,513	2,441
Tmt. Mean	105.0	105.6	104.7	106.1
No. Observations	20	25	24	23

APPENDIX TABLE 9(a)

The analysis of variance of the body weight (lb.) on Oct. 1, 1955 (approx. 42 mths. of age) of the groups of ewes (1952 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F
Total	91	7,412		
Between Total Tmts.	3	28	9.3	
Within Tmts.	88	7,384	83.9	

APPENDIX TABLE 10

The body weight (lb.) on Oct. 2, 1956 (approx. 54 mths. of age) of the groups of ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	113	116	-	116
	-	107	102	103
	-	112	103	-
	111	106	-	-
	110	106	115	-
	-	112	114	-
	104	118	104	115
Heft Total	438	777	538	334
" Mean	109.5	111.0	107.6	111.3
Howgate	114	93	-	-
	110	108	-	-
	-	112	-	-
	118	128	119	124
	-	-	125	107
	-	-	-	107
	-	-	94	115
Heft Total	342	441	338	453
" Mean	114	110.2	112.7	113.2
Front	105	111	114	123
	98	125	-	110
	-	116	-	-
	-	-	120	115
	123	-	105	109
	93	132	-	118
	96	-	-	103
Heft Total	515	484	339	678
" Mean	103	121	113	113
West Park	-	-	111	112
	129	116	120	126
	107	113	112	114
	130	102	100	114
	-	112	113	136
	121	107	110	122
	114	105	110	117
Heft Total	601	655	776	841
" Mean	120.2	109.2	110.9	120.1
Tmt. Total	1,896	2,351	1,991	2,306
Tmt. Mean	111.5	112.2	110.6	115.3
No. Observations	17	21	18	20

APPENDIX TABLE 10(a)

The analysis of variance of the body weight (lb.) on Oct. 2, 1956 (approx. 54 mths. of age) of the groups of ewes (1952 trial) which received different wintering treatments as hoggs

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	75	6,419				
Between Winterings	3	244	81.3			
Within Winterings	72	6,175	85.8			
Comparison:						
Winterings						
Inbye ½ v. Rest	1	225	225.0	2.62	3.98	7.01

APPENDIX TABLE 11

The body weight (lb.) on Sept. 12, 1957 (approx. 66 mths. old) of the groups of ewes (1952 trial) having received four different hoggt wintering treatments

		Hill	Away	Inbye	Inbye ½
Boghall		126	118	-	128
		-	129	112	-
		-	118	-	-
		115	106	-	-
		122	106	-	-
		-	105	129	-
		107	134	116	116
	Heft Total	470	816	357	244
	" Mean	117.5	116.6	119	122
Howgate		119	96	-	-
		108	-	-	-
		-	121	-	-
		-	123	116	118
		-	-	128	97
		-	-	-	124
		-	-	110	116
	Heft Total	227	340	354	455
	" Mean	113.5	113.3	118	113.7
Front		110	115	114	124
		105	121	-	114
		-	-	-	-
		-	-	-	112
		112	-	108	114
		104	122	-	126
		89	-	-	110
	Heft Total	520	358	222	700
	" Mean	104	119.3	111	116.7
West Park		-	-	124	-
		120	130	135	136
		-	-	122	120
		-	101	-	122
		-	121	116	124
		-	112	118	128
		114	96	119	128
	Heft Total	234	560	734	758
	" Mean	117	112	122.3	126.3
Tmt. Total		1,451	2,074	1,667	2,157
Tmt. Mean		111.6	115.2	119.1	119.8
No. Observations		13	18	14	18

APPENDIX TABLE 11(a)

The analysis of variance of the body weight (lb.) on Sept. 12, 1957 (approx. 66 mths. old) of ewes (1952 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	62	6,058				
Between Winterings	3	630	210	2.28	2.76	4.13
Within Winterings	59	5,428	92			
Comparisons:						
Winterings						
Hill v. Rest	1	415	415	4.51*	4.0	7.17
Hill v. Away	1	98	98	1.06	4.0	7.17
Inbye ½ v. Away	1	191	191	2.08	4.0	7.17

* Significant at $P < .05$.

APPENDIX TABLE 12

The changes in body weight (lb.) from October 1953 to October 1954 of the B.F. ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	+ 16	- 13	+ 9	+ 5
	-	- 5	+ 18	- 1
	-	+ 5	+ 15	-
	+ 14	- 9	+ 4	+ 16
	+ 7	- 12	+ 4	-
	- 6	- 6	+ 1	- 5
	+ 18	+ 3	+ 9	+ 12
Heft Mean	+ 9.8	- 5.3	+ 8.6	+ 5.4
Howgate	+ 12	- 4	-	- 11
	+ 10	- 12	-	+ 5
	+ 20	0	- 5	0
	+ 5	+ 2	+ 2	+ 6
	-	- 16	+ 2	- 3
	-	- 9	+ 2	- 2
	-	- 3	- 2	+ 12
Heft Mean	+ 11.7	- 6.0	- 0.2	+ 1.0
Front	+ 9	+ 5	- 2	+ 4
	+ 9	+ 8	+ 4	+ 7
	- 12	+ 7	0	-
	-	+ 34	+ 5	+ 2
	+ 17	-	+ 2	+ 2
	+ 7	- 1	- 16	+ 5
	+ 1	- 10	-	+ 15
Heft Mean	+ 5.1	+ 7.1	- 1.2	+ 5.8
West Park	-	-	- 4	- 5
	- 11	- 11	+ 14	+ 6
	+ 2	- 7	+ 22	+ 6
	+ 2	+ 6	0	+ 9
	+ 10	- 1	0	- 10
	0	+ 2	0	+ 9
	- 4	+ 4	- 5	+ 17
Heft Mean	- 0.2	- 1.2	+ 3.9	+ 4.6
Tmt. Total	+126	- 43	+ 79	+101
Tmt. Mean	+ 6.0	- 1.65	+ 3.16	+ 4.04
No. Observations	21	26	25	25

APPENDIX TABLE 12(a)

The analysis of variance of the changes in body weight (lb.) from October 1953 to October 1954 of the B.F. ewes (1952 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	96	7,900				
Between Winterings	3	772	257	3.35*	2.71	3.98
Within Winterings	93	7,128	76.6			
Comparison:						
Away v. Hill	1	681	681	8.89**	3.95	6.93
Away v. Inbye	1	412	412	5.37*		

* Significant at $P < .05$.
** Significant at $P < .01$.

APPENDIX TABLE 13

The mean hind cannon bone length (cm.) at various stages of development of the groups of B.F. sheep (1952 trial) given four different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½	Overall
Initial length	1/10/52	17.95	18.08	18.33	18.17	18.13
3 months	6/1/53	18.21	18.61	18.63	18.78	18.56
6 "	1/4/53	18.40	19.37	19.20	18.80	18.97
9 "	22/6/53	18.98	19.58	19.60	19.30	19.38
13 "	29/10/53	19.16	19.58	19.74	19.51	19.50
37 "	1/10/55	19.47	19.70	20.06	19.68	19.70
49 "	2/10/56	19.38	19.62	20.12	19.60	19.68
60 "	12/9/57	19.51	19.78	20.21	19.71	19.82

APPENDIX TABLE 14

The length of the hind cannon bone (cm.) of ewe hoggs (1952 trial) on Oct. 1, 1952, before four different wintering treatments were given

		Hill	Away	Inbye	Inbye ½
Boghall		18.7	19.4	18.0	18.1
		18.2	18.5	17.8	18.8
		16.7	17.5	19.2	17.2
		17.9	17.4	18.0	19.2
		18.4	18.7	20.2	16.9
		17.4	17.7	18.8	17.6
		17.4	18.0	17.8	17.3
	Heft Total	124.7	127.2	129.8	125.1
	" Mean	17.8	18.2	18.5	17.9
Howgate		18.8	17.6	17.4	20.4
		17.9	18.2	18.0	17.4
		18.8	19.1	19.2	18.5
		17.2	18.6	19.0	19.0
		18.0	18.2	19.0	17.4
		18.2	18.2	17.2	17.4
		17.2	18.0	18.0	17.3
	Heft Total	126.2	127.9	127.8	127.4
	" Mean	18.0	18.3	18.3	18.2
Front		17.4	17.4	17.3	18.4
		18.4	17.7	17.8	18.7
		17.8	16.9	16.8	17.7
		17.7	18.2	19.0	17.6
		18.4	19.2	18.1	18.3
		17.8	18.0	18.2	18.1
		17.7	18.0	17.5	18.0
	Heft Total	125.2	125.4	124.7	126.8
	" Mean	17.9	17.9	17.8	18.1
West Park		17.2	17.2	19.1	18.8
		18.2	18.2	19.7	19.2
		17.9	17.6	18.5	17.4
		19.2	18.0	18.3	18.5
		17.2	17.8	18.5	17.8
		18.4	18.6	19.2	19.1
		18.3	18.3	17.8	18.6
	Heft Total	126.4	125.7	131.1	129.4
	" Mean	18.1	18.0	18.7	18.5
Tmt. Total		502.5	506.2	513.4	508.7
Tmt. Mean		17.95	18.08	18.33	18.17

APPENDIX TABLE 14(a)

The analysis of variance of the length of the hind cannon bone (cm.) of ewe hoggs (1952 trial) on Oct. 1, 1952, before four different wintering treatments were given

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	111	54.99				
Between Total Tmts.	15	7.78				
Winterings	3	2.24	0.75	1.96	3.86	6.99
Hefts	3	2.10	0.70	1.83		
Heft x Wintering	9	3.44	0.382			
Within Winterings	96	47.21	0.492			
Comparison:						
Winterings						
Hill & Away v. Inbye & Inbye ½	1	2.0	2.0	5.2 *	5.12	10.56
Hefts						
Front v. West Park	1	1.97	1.97	5.16*	5.12	10.56

* Significant at $P < .05$.

APPENDIX TABLE 15

The length of the hind cannon bone (cm.) of ewe hoggs (1952 trial) on Jan. 6, 1953, midway through four different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½
Boghall		19.1	20.2	18.8	19.2
		18.4	19.2	18.4	19.2
		17.2	18.1	19.8	17.6
		18.0	17.8	18.1	19.8
		18.4	19.6	20.6	17.6
		17.6	18.1	19.0	18.2
		17.6	18.6	18.1	18.2
	Heft Total	126.3	131.6	132.8	129.8
	" Mean	18.0	18.8	19.0	18.5
Howgate		19.0	17.9	17.6	20.9
		18.0	19.0	17.9	18.3
		19.2	19.8	19.2	19.4
		18.0	19.2	19.1	19.4
		18.4	19.0	19.7	18.0
		18.6	18.6	17.0	18.2
		17.2	18.4	18.0	18.2
	Heft Total	128.4	131.9	128.5	132.4
	" Mean	18.3	18.8	18.4	18.9
Front		18.0	18.2	17.8	18.6
		18.4	18.2	18.0	19.2
		18.2	17.4	16.5	18.0
		18.0	18.4	19.6	18.2
		18.3	19.6	18.8	18.8
		17.9	18.6	18.8	18.9
		18.2	18.4	17.5	18.6
	Heft Total	127.0	128.8	127.0	130.3
	" Mean	18.1	18.4	18.1	18.6
West Park		17.0	17.5	19.5	19.5
		18.4	18.4	20.2	19.6
		18.1	18.0	18.6	18.0
		19.4	18.4	18.2	19.2
		17.6	18.2	19.1	18.2
		19.0	19.4	20.0	19.8
		18.8	18.8	17.9	19.2
	Heft Total	128.3	128.7	133.5	133.5
	" Mean	18.3	18.4	19.1	19.1
Tmt. Total		510.0	521.0	521.8	526.0
Tmt. Mean		18.21	18.61	18.63	18.78

APPENDIX TABLE 15(a)

The analysis of variance of the length of the hind cannon bone (cm.) of ewe hoggs (1952 trial) on Jan. 6, 1953, midway through four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	111	70.77				
Between Total Tmts.	15	12.36				
Winterings	3	4.98	1.66	2.95	3.86	6.99
Hefts	3	2.32	0.77			
Heft x Wintering	9	5.06	0.562			
Within Tmts.	96	58.41	0.608			
Comparisons:						
Wintering						
Hill v. Rest	1	4.2	4.2	7.47*	5.12	10.56

* Significant at $P < .05$.

APPENDIX TABLE 16

The length of the hind cannon bone (cm.) of ewe hoggs (1952 trial) on April 1, 1953, at the end of four different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½
Boghall		19.6	21.3	19.4	19.7
		18.7	20.0	18.9	19.2
		17.2	18.9	20.5	17.6
		18.4	18.6	18.7	19.7
		19.0	20.2	21.2	17.6
		17.9	18.9	19.7	18.5
		18.2	18.9	18.9	18.2
	Heft Total	129.0	136.8	137.3	130.5
	" Mean	18.4	19.5	19.6	18.7
Howgate		19.4	18.6	18.0	21.1
		18.2	19.7	18.0	18.3
		19.2	20.9	19.8	19.7
		18.2	20.2	19.9	19.7
		18.5	19.5	20.2	18.0
		18.6	19.7	18.2	18.3
		17.2	19.6	18.8	18.2
	Heft Total	129.3	138.2	132.9	133.3
	" Mean	18.5	19.7	19.0	19.0
Front		18.0	19.1	18.3	18.8
		18.6	18.9	18.6	19.3
		18.2	17.7	17.4	17.8
		17.8	19.3	19.9	18.4
		18.7	20.0	19.2	18.9
		18.2	19.6	19.3	18.9
		18.6	19.6	18.5	18.8
	Heft Total	128.1	134.2	131.2	130.9
	" Mean	18.3	19.2	18.7	18.7
West Park		17.1	18.1	20.2	19.4
		18.2	18.9	20.5	19.6
		18.4	18.9	19.1	17.9
		19.5	19.1	19.2	18.6
		17.5	18.8	19.6	18.4
		19.2	20.0	20.3	19.8
		18.8	19.3	18.9	19.3
	Heft Total	128.7	133.1	137.8	133.0
	" Mean	18.4	19.0	19.7	19.0
Tmt. Total		515.0	542.3	539.2	527.7
Tmt. Mean		18.40	19.37	19.20	18.80

APPENDIX TABLE 16(a)

The analysis of variance of the length of the hind cannon bone (cm.) of ewe hoggs (1952 trial) on April 1, 1953, at the end of four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	111	62.87				
Between Total Tmts.	15	24.22				
Winterings	3	16.34	5.45	8.65**	3.86	6.99
Hefts	3	2.15	0.72	1.14	3.86	6.99
Heft x Wintering	9	5.69	0.63	1.56	1.97	2.59
Within Winterings	96	38.65	0.403			
Comparison:						
Winterings						
Hill v. Rest	1	12.34	12.34	19.6 **	5.12	10.56
Hill v. Inbye ½	1	2.84	2.84	4.5		
Hefts						
Front v. Rest	1	2.12	2.12	3.36	5.12	10.56

** Significant at $P < .01$.

APPENDIX TABLE 17

The length of the hind cannon bone (cm.) on June 22, 1953 (approx. 14 mths. of age) of ewe hoggs (1952 trial) having received four different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½
Boghall		19.7	22.0	19.8	20.2
		19.5	20.4	19.2	19.6
		17.6	19.2	20.7	18.0
		19.0	18.6	19.2	20.2
		19.8	20.3	21.8	18.1
		18.8	19.2	19.9	19.0
		18.4	19.0	19.2	18.4
	Heft Total	132.8	138.7	139.8	133.5
	" Mean	19.0	19.8	20.0	19.1
Howgate		20.0	18.8	18.7	21.7
		18.8	20.2	18.3	18.8
		19.7	21.4	20.1	20.0
		18.7	20.5	20.3	20.4
		19.4	19.4	20.6	18.7
		19.0	19.6	18.6	18.7
		18.2	19.8	19.0	18.4
	Heft Total	133.8	139.7	135.6	136.7
	" Mean	19.1	19.9	19.4	19.5
Front		18.6	19.2	18.6	19.2
		18.9	19.1	18.9	19.7
		18.6	17.8	18.0	18.2
		18.3	19.4	20.6	19.0
		18.8	20.2	19.6	19.4
		19.0	20.1	20.1	19.4
		18.8	19.8	18.8	19.4
	Heft Total	131.0	135.6	134.6	134.3
	" Mean	18.7	19.4	19.2	19.2
West Park		18.0	18.2	20.5	20.2
		18.9	19.1	20.8	20.4
		19.1	18.8	19.2	18.6
		20.2	19.2	19.2	19.2
		18.2	19.0	19.5	18.4
		20.0	20.3	20.6	20.2
		19.6	19.6	19.4	20.0
	Heft Total	134.0	134.2	139.2	137.2
	" Mean	19.1	19.2	19.9	19.6
Tmt. Total		531.6	548.2	549.2	541.7
Tmt. Mean		18.98	19.58	19.60	19.30

APPENDIX TABLE 17(a)

The analysis of variance of the length of the hind cannon bone (cm.) on June 22, 1953 (approx. 14 mths. of age) of ewe hoggs (1952 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	111	122.97				
Between Total Tmts.	15	14.88				
Winterings	3	7.01	2.34	3.90*	3.86	6.99
Hefts	3	2.48	0.83	1.38		
Heft x Wintering	9	5.39	0.60			
Within Tmts.	96	108.09	1.12			
Comparison:						
Winterings						
Hill v. Rest	1	5.8	5.8	9.6 *	5.12	10.56
Inbye $\frac{1}{2}$ v. Inbye	1	1.0	1.0	1.67		

* Significant at $P < .05$.

APPENDIX TABLE 18

The length of the hind cannon bone (cm.) on October 29, 1953 of ewe hoggs (1952 trial) having received four different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½
		20.0	22.2	20.0	20.6
		19.7	20.5	19.6	19.9
		17.9	19.0	20.7	18.1
Boghall		19.2	18.6	19.2	20.8
		19.8	20.4	21.7	18.2
		18.8	19.0	20.0	19.1
		18.6	19.1	19.3	18.6
	Heft Total	134.0	138.8	140.5	135.3
	" Mean	19.1	19.8	20.1	19.3
		20.0	18.7	18.6	21.8
		19.1	20.2	18.6	19.2
		20.0	21.3	20.4	20.2
Howgate		19.0	20.6	20.5	20.4
		19.8	19.4	20.4	18.8
		19.0	19.6	18.6	18.7
		18.6	19.7	19.2	18.6
	Heft Total	135.5	139.5	136.3	137.9
	" Mean	19.4	19.9	19.5	19.7
		18.7	19.5	18.8	19.6
		19.1	19.2	19.0	19.6
		18.7	17.8	18.0	18.7
Front		18.5	19.4	21.1	19.2
		18.8	20.2	19.6	19.5
		19.0	19.8	20.2	19.4
		18.8	19.7	19.1	19.3
	Heft Total	131.6	135.6	135.8	135.3
	" Mean	18.8	19.4	19.4	19.3
		18.4	18.4	20.4	20.2
		19.1	19.0	21.0	20.3
		19.1	19.0	19.5	18.7
West Park		20.2	19.3	19.5	19.6
		18.6	19.2	19.6	18.8
		20.3	20.2	20.8	20.2
		19.8	19.4	19.4	20.0
	Heft Total	135.5	134.5	140.2	137.8
	" Mean	19.4	19.2	20.0	19.7
Tmt. Total		536.6	548.4	552.8	546.3
Tmt. Mean		19.16	19.58	19.7	19.5

APPENDIX TABLE 18(a)

The analysis of variance of the length of the hind cannon bone (cm.) on Oct. 29, 1953 of ewe hoggs (1952 trial) having received four different hoggs wintering treatments

Source	d.f.	d.f.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	111	78.63				
Between Total Tmts.	15	12.53				
Winterings	3	5.0	1.67	3.21	3.86	
Hefts	3	2.86	0.95	1.82		
Heft x Wintering	9	4.67	0.52	-		
Within Tmts.	96	66.10	.688			
Comparison:						
Winterings						
Hill v. Rest	1	4.22	4.22	8.1 **	5.12	10.56
Hefts						
Front v. Rest	1	2.83	2.83	5.44**	5.12	10.56

** Significant at $P < .01$.

APPENDIX TABLE 19

The length of the hind cannon bone (cm.) on Oct. 1, 1955 of ewes (1952 trial)

	Hill	Away	Inbye	Inbye ½
Boghall	20.0	22.3	20.4	20.8
	-	20.6	19.6	20.2
	-	19.2	21.0	18.3
	19.0	18.8	19.3	20.9
	19.8	20.6	21.8	18.4
	19.0	19.2	20.3	19.2
	18.7	19.1	19.5	18.8
Howgate	20.4	19.0	-	-
	19.2	20.4	-	-
	-	21.2	-	-
	19.2	20.8	20.5	20.7
	-	-	20.8	19.1
	-	-	-	19.2
	-	-	19.3	18.8
Front	18.9	19.6	19.0	19.8
	19.4	19.3	-	19.9
	-	18.0	18.0	-
	-	19.3	20.8	19.4
	19.2	-	19.6	19.9
	19.1	20.0	20.0	19.6
	19.1	-	-	19.6
West Park	-	-	20.5	20.4
	19.2	19.2	21.5	20.6
	19.2	18.9	19.8	18.7
	20.6	19.3	19.6	19.8
	-	19.0	19.8	19.1
	20.4	20.3	20.7	20.3
	20.0	19.4	19.6	20.0
Tmt. Total	350.4	433.5	441.4	472.3
Tmt. Mean	19.47	19.70	20.06	19.68
No. Observations	18	22	22	24

APPENDIX TABLE 19(a)

The analysis of variance of the length of the hind cannon bone (cm.) on Oct. 1, 1955 of the ewes (1952 trial) after having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	85	58.29				
Between Winterings	3	3.77	1.26	1.91	2.72	4.04
Within Winterings	82	54.52	0.66			
Comparison:						
Hill v. Rest	1	1.69	1.69	2.56	3.96	6.96

APPENDIX TABLE 20

The length of the hind cannon bone (cm.) on Oct. 2, 1956 of the ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	20.0	21.9	-	20.7
	-	20.6	19.4	20.2
	-	19.3	20.8	-
	19.1	18.8	-	-
	19.8	20.8	21.7	-
	-	19.1	20.2	-
	18.7	19.1	19.4	18.5
Howgate	20.1	18.7	-	-
	19.1	-	-	-
	-	21.2	-	-
	19.2	20.5	20.4	20.5
	-	-	20.8	19.0
	-	-	-	19.0
	-	-	19.2	18.5
Front	18.6	19.6	19.0	19.7
	19.2	19.2	-	19.8
	-	17.9	-	-
	-	-	20.8	19.4
	19.0	-	19.3	19.7
	18.8	20.0	-	19.4
	19.0	-	-	19.4
West Park	-	-	20.4	20.3
	19.2	19.0	21.4	20.4
	18.8	18.8	19.6	18.6
	20.5	19.4	19.7	19.8
	-	19.0	19.6	18.8
	20.6	20.2	20.9	20.3
	19.8	19.4	19.5	20.0
Tmt. Total	329.5	392.5	362.1	392.0
Tmt. Mean	19.38	19.62	20.12	19.60
No. Observations	17	20	18	20

APPENDIX TABLE 20(a)

The analysis of variance of the length of the hind cannon bone (cm.) on Oct. 2, 1956 of the ewes (1952 trial) after having received four different hoeg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	74	49.81				
Between Winterings	3	5.11	1.70	2.70	2.74	4.08
Within Winterings	71	44.70	0.63			
Comparison:						
Hill v. Rest	1	1.95	1.95	3.09	3.98	7.01

APPENDIX TABLE 21

The length of the hind cannon bone (cm.) on Sept. 12, 1957 of the ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	20.2	22.2	-	21.0
	-	20.8	19.6	20.2
	-	19.4	-	-
	19.3	18.7	-	-
	20.0	20.5	22.0	-
	-	19.3	20.4	-
	18.7	19.3	19.6	18.7
Howgate	20.4	18.6	-	-
	19.4	-	-	-
	-	21.5	-	-
	-	20.8	20.6	20.8
	-	-	21.0	19.1
	-	-	-	19.2
	-	-	19.6	18.7
Front	18.9	19.6	19.2	20.1
	19.2	19.5	-	19.7
	-	18.0	-	-
	-	-	21.0	19.4
	19.2	-	19.6	19.8
	19.2	20.0	-	19.6
	19.0	-	-	19.5
West Park	-	-	20.8	-
	19.4	19.2	21.4	20.6
	19.3	-	19.6	18.8
	-	19.4	19.7	19.8
	-	19.2	19.6	19.2
	20.5	20.4	20.6	20.4
	20.0	19.5	19.8	20.0
Tmt. Total	292.7	375.9	344.1	374.6
Tmt. Mean	19.51	19.78	20.2	19.71
No. Observations	15	19	17	19

APPENDIX TABLE 21(a)

The analysis of variance of the hind cannon bone (cm.) on Sept. 12, 1957 of the ewes (1952 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	69	47.01				
Between Winterings	3	4.65	1.55	2.42	2.75	4.10
Within Winterings	66	42.36	0.64			
Comparison:						
Hill v. Rest	1	1.78	1.78	2.78	3.99	7.04

APPENDIX TABLE 22

The mean pelvic bone length (cm.) at various stages of development of the groups of B.F. sheep (1952 trial) given four different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½	Overall
Initial length	1/10/52	19.14	18.92	19.07	19.16	19.07
After 3 months	6/1/53	19.09	19.72	19.57	19.66	19.51
" 6 "	1/4/53	19.12	20.97	19.98	19.63	19.93
" 9 "	22/6/53	20.10	21.24	20.45	20.47	20.57
" 13 "	29/10/53	21.20	21.97	21.43	21.45	21.51
" 37 "	1/10/55	22.09	22.15	21.92	22.13	22.07
" 49 "	2/10/56	22.15	22.19	22.05	22.10	22.12
" 60 "	12/9/57	22.14	22.14	22.15	22.21	22.16

APPENDIX TABLE 23

The length of pelvic bone (cm.) of ewe hoggs (1952 trial) on Oct. 1, 1952, before four different hogg wintering treatments were given

		Hill	Away	Inbye	Inbye ½
Boghall		19.8	19.0	17.2	18.2
		18.6	18.4	18.6	20.0
		18.5	18.0	19.5	18.0
		19.8	19.4	19.0	19.4
		19.2	18.9	20.6	18.6
		17.7	19.9	19.6	18.8
		19.2	18.8	18.5	19.5
	Heft Total	132.8	132.4	133.0	132.5
	" Mean	19.0	18.9	19.0	18.9
Howgate		20.0	19.0	18.2	20.0
		18.9	18.0	17.9	19.0
		19.2	18.7	18.9	19.0
		19.2	19.8	19.2	19.5
		18.3	19.1	19.6	17.1
		19.7	20.0	18.4	18.8
		16.6	17.6	18.5	19.5
	Heft Total	131.9	132.2	130.7	132.9
	" Mean	18.8	18.9	18.7	19.0
Front		18.8	18.0	18.5	18.8
		19.6	19.0	19.6	19.8
		19.6	18.2	18.4	19.2
		19.0	19.4	19.4	18.4
		20.4	19.5	18.7	19.2
		19.0	18.4	19.6	19.4
		19.2	18.4	18.3	19.0
	Heft Total	135.6	130.9	132.5	133.8
	" Mean	19.4	18.7	18.9	19.1
West Park		18.3	18.2	19.8	19.5
		21.0	20.2	20.0	20.4
		19.2	19.2	19.5	19.1
		20.7	18.2	19.1	19.0
		18.7	19.2	20.0	19.9
		19.2	19.6	20.0	20.1
		18.5	19.6	19.4	19.2
	Heft Total	135.6	134.2	137.8	137.2
	" Mean	19.4	19.2	19.7	19.6
Tmt. Total		535.9	529.7	534.0	536.4
Tmt. Mean		19.14	18.92	19.07	19.16

APPENDIX TABLE 23(a)

The analysis of variance of the length of pelvic bone (cm.) of ewe hoggs (1952 trial) on Oct. 1, 1952, before four different hogg wintering treatments were given

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	111	64.43				
Between Total Tmts.	15	9.25				
Winterings	3	.99	.33	1.3	3.86	6.99
Hefts	3	6.02	2.01	4.0	3.86	6.99
Heft x Wintering	9	2.24	.25	-	1.97	2.59
Within Tmts.	96	55.18	.574			
Comparison:						
Hefts						
West Park v. Rest	1	5.54	5.54	22.16**	5.12	10.56

** Significant at $P < .01$.

APPENDIX TABLE 24

The length of pelvic bone (cm.) of the ewe hoggs (1952 trial) on Jan. 8, 1953, midway through four different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½
		19.7	19.7	18.0	18.6
		18.8	19.2	19.9	19.9
		18.6	18.0	20.9	18.1
Boghall		19.6	20.0	19.2	19.7
		19.1	19.4	22.0	19.6
		17.6	20.2	20.2	19.4
		19.4	19.9	17.9	19.5
	Heft Total	132.8	136.4	138.1	134.8
	" Mean	19.0	19.5	19.7	19.3
		19.5	19.8	19.0	21.0
		18.8	19.2	17.6	18.6
		18.9	19.3	19.6	20.0
Howgate		19.2	20.6	20.0	20.7
		18.2	20.4	20.4	17.8
		19.6	21.1	18.2	19.6
		16.8	18.2	18.1	19.5
	Heft Total	131.0	138.6	132.9	137.2
	" Mean	18.7	19.8	19.0	19.6
		19.0	19.4	19.1	19.7
		19.2	19.6	20.3	20.0
		20.0	18.9	18.0	20.0
Front		19.5	20.4	20.4	19.0
		20.2	20.2	20.0	20.1
		19.0	19.6	20.2	20.2
		19.7	19.1	18.5	19.4
	Heft Total	136.6	137.2	136.5	138.4
	" Mean	19.5	19.6	19.5	19.8
		17.7	19.0	20.2	19.7
		20.8	20.0	20.3	20.9
		18.8	20.4	19.8	19.5
West Park		20.3	19.4	18.9	19.0
		18.7	20.4	21.6	20.4
		19.0	20.4	20.4	21.0
		18.8	20.4	19.2	19.6
	Heft Total	134.1	140.0	140.4	140.1
	" Mean	19.2	20.0	20.1	20.0
Tmt. Total		534.5	552.2	547.9	550.5
Tmt. Mean		19.09	19.72	19.57	19.66

APPENDIX TABLE 24(a)

The analysis of variance of the length of pelvic bone (cm.) of the ewe hoggs (1952 trial) on Jan. 8, 1953, midway through four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	111	91.68				
Between Total Tmts.	15	16.78				
Winterings	3	6.93	2.31	4.20*	3.86	6.99
Hefts	3	4.85	1.62	2.94		
Heft x Wintering	9	5.00	.55	-		
Within Tmts.	96	74.90	.78			
Comparison:						
Winterings						
Hill v. Rest	1	6.60	6.60	12.00**	5.12	10.56
Hefts						
West Park v. Rest	1	3.29	3.29	5.98*	5.12	10.56

** Significant at $P < .01$.
* Significant at $P < .05$.

APPENDIX TABLE 25

The length of pelvic bone (cm.) of the ewe horns (1952 trial) on April 1, 1953, at the end of four different hoggs wintering treatments

		Hill	Away	Inbye	Inbye
Boghall		19.7	21.6	19.0	18.6
		18.8	20.9	20.0	19.6
		18.7	19.8	20.8	18.5
		19.9	21.6	20.0	19.7
		19.4	20.5	20.9	19.5
		17.7	21.5	21.0	18.9
		19.7	20.7	19.4	19.7
	Heft Total	133.9	146.6	141.1	134.5
	" Mean	19.1	20.9	20.1	19.2
Howgate		19.8	21.1	18.2	21.2
		18.9	20.5	18.8	18.7
		18.8	21.2	19.7	20.0
		19.3	22.2	20.8	20.6
		18.4	21.6	20.6	17.8
		19.3	20.0	19.1	19.7
		16.6	20.4	19.2	19.7
	Heft Total	131.1	147.0	136.4	137.7
	" Mean	18.7	21.0	19.5	19.7
Front		19.1	21.0	19.2	19.7
		19.1	20.7	19.9	19.6
		19.4	19.3	19.3	19.6
		19.2	21.6	20.4	19.2
		20.3	20.9	19.8	20.2
		19.3	20.8	20.6	20.2
		20.2	20.8	18.8	19.4
	Heft Total	136.6	145.1	138.0	137.9
	" Mean	19.5	20.7	19.7	19.7
West Park		17.4	19.7	20.8	19.5
		20.8	21.6	20.6	20.8
		18.9	22.0	20.0	19.2
		19.9	20.8	20.1	18.7
		18.5	21.5	21.4	20.7
		19.1	21.5	20.8	20.8
		19.2	21.5	20.3	19.8
	Heft Total	133.8	148.6	144.0	139.5
	" Mean	19.1	21.2	20.6	19.9
Tmt. Total		535.4	537.3	559.5	549.6
Tmt. Mean		19.12	20.97	19.98	19.63

APPENDIX TABLE 25(a)

The analysis of variance of the length of pelvic bone (cm.) of the ewe hoggs (1952 trial) on April 1, 1953, at the end of four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	111	116.43				
Between Total Tmts.	15	61.29				
Winterings	3	51.49	17.16	24.76**	3.86	6.99
Hefts	3	3.56	1.19	1.72	3.86	6.99
Heft x Wintering	9	6.24	.693	1.23	1.97	2.59
Within Tmts.	96	54.19	.564			
Comparison:						
Winterings						
Hill v. Rest	1	24.21	24.21	34.9 **	5.12	10.56
Away v. Inbye	1	13.80	13.80	19.91**	5.12	10.56
Hill v. Inbye ½	1	3.60	3.60	5.19*	5.12	10.56
Hefts						
West Park v. Rest	1	3.01	3.01	4.34	5.12	10.56

** Significant at P <.01.
* Significant at P <.05.

APPENDIX TABLE 26

The length of pelvic bone (cm.) on June 22, 1953 of the ewe hoggs (1952 trial) having received four different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½
Boghall		20.8	21.7	19.6	19.8
		20.0	21.4	20.4	20.4
		19.5	20.4	21.0	19.4
		20.9	21.8	20.0	20.2
		20.4	21.0	21.6	20.6
		18.8	21.6	21.6	20.1
		20.9	21.3	20.2	20.8
	Heft Total	141.3	149.2	144.4	141.3
	" Mean	20.2	21.3	20.6	20.2
Howgate		21.0	20.8	19.0	21.9
		20.0	21.4	19.3	19.5
		19.2	21.6	20.5	21.2
		20.6	22.6	21.4	21.6
		19.4	21.7	20.6	18.6
		20.0	22.2	19.8	20.3
		17.7	20.3	19.5	20.8
	Heft Total	137.9	150.6	140.1	143.9
	" Mean	19.7	21.5	20.0	20.6
Front		20.2	21.2	19.8	19.7
		20.0	20.8	20.5	20.4
		20.1	19.3	19.8	20.2
		20.1	22.1	21.7	20.6
		20.9	21.1	20.5	21.3
		20.5	21.2	21.5	21.0
		20.8	20.9	19.2	20.0
	Heft Total	142.6	146.6	142.0	143.2
	" Mean	20.4	20.9	20.3	20.5
West Park		18.5	19.5	21.0	20.4
		21.8	21.4	20.9	21.5
		20.2	21.7	20.4	20.4
		20.9	20.8	20.3	19.4
		19.1	21.6	21.4	21.2
		20.4	21.3	21.2	21.6
		20.2	21.9	20.9	20.4
	Heft Total	141.1	148.2	146.1	144.9
	" Mean	20.1	21.2	20.9	20.7
Tmt. Total		562.9	594.6	572.6	573.3
Tmt. Mean		20.10	21.24	20.45	20.47

APPENDIX TABLE 26(a)

The analysis of variance of the length of pelvic bone (cm.) on June 22, 1953 of the ewe hoggs (1952 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	111	106.53				
Between Tmts.	15	26.05				
Winterings	3	19.16	6.39	10.1 **	3.86	6.99
Hefts	3	1.19	.39			
Heft x Wintering	9	5.70	.63			
Within Tmts.	96	80.48	.84			
Comparison:						
Wintering						
Hill v. Rest	1	8.00	8.00	12.70**	5.12	10.56
Hill v. Inbye	1	1.68	1.68	2.67	5.12	10.56
Away v. Inbye	1	8.64	8.64	13.71**	5.12	10.56

** Significant at $P < .01$.

APPENDIX TABLE 27

The length of pelvic bone (cm.) on Oct. 29, 1953 of the ewe hoggs (1952 trial) having received four different hoggs wintering treatments

		Hill	Away	Inbye	Inbye ½
Boghall		21.9	22.5	20.6	20.8
		21.0	21.8	21.4	21.4
		20.6	21.5	21.8	20.4
		21.3	22.8	21.2	21.6
		21.5	21.8	22.4	21.4
		19.7	22.5	21.9	20.5
		21.9	21.8	21.2	21.7
	Heft Total	147.9	154.7	150.5	147.8
	" Mean	21.1	22.1	21.5	21.1
Howgate		22.2	21.4	19.9	22.6
		20.8	22.1	20.4	20.6
		20.4	22.8	21.6	22.0
		21.9	23.3	22.0	22.8
		20.4	22.4	22.0	19.4
		21.0	22.8	20.4	21.3
		18.7	21.0	20.6	21.7
	Heft Total	145.4	155.8	146.9	150.4
	" Mean	20.8	22.3	21.0	21.5
Front		21.0	21.6	21.0	21.4
		20.8	21.2	21.7	21.4
		21.8	20.3	20.5	21.6
		21.1	22.7	22.6	21.1
		21.1	21.7	21.5	22.2
		21.6	21.9	22.6	22.0
		22.2	21.3	19.9	20.8
	Heft Total	149.6	150.7	149.8	150.5
	" Mean	21.4	21.5	21.4	21.5
West Park		20.0	20.1	21.6	21.1
		23.2	22.6	21.9	22.7
		21.2	22.8	21.6	21.5
		22.4	21.4	21.1	20.5
		20.6	22.2	22.4	22.4
		21.8	22.2	22.0	22.4
		21.4	22.6	22.2	21.3
	Heft Total	150.6	153.9	152.8	151.9
	" Mean	21.5	22.0	21.8	21.7
Tmt. Total		593.5	615.1	600.0	600.6
Tmt. Mean		21.20	21.97	21.43	21.45

APPENDIX TABLE 27(a)

The analysis of variance of the length of pelvic bone (cm.) on Oct. 29, 1953 of the ewe hoggs (1952 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	111	80.61				
Between Total Tmts.	15	16.98				
Winterings	3	8.91	2.97	4.71*	3.86	6.99
Hefts	3	2.39	0.79	-		
Heft x Wintering	9	5.68	.63	-		
Within Tmts.	96	63.63	.66			
Comparisons:						
Winterings						
Away v. Inbye	1	4.07	4.07	6.46*	5.12	10.56
Hill v. Inbye	1	0.76	0.76	1.20	5.12	10.56

* Significant at $P < .05$.

APPENDIX TABLE 28

The length of the pelvic bone (cm.) on Oct. 1, 1955 of the ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	22.8	22.3	20.7	22.6
	-	22.1	22.1	22.1
	-	21.1	22.5	-
	22.0	22.4	21.0	22.5
	22.0	21.7	22.4	21.7
	20.3	22.6	22.7	22.0
	22.5	23.2	21.6	22.5
Howgate	22.4	21.5	-	-
	21.8	21.8	-	-
	-	22.2	-	-
	22.3	24.1	22.4	22.9
	-	-	22.6	19.7
	-	-	-	21.7
	-	-	20.9	22.5
Front	21.6	22.0	21.3	22.0
	21.0	21.4	-	22.8
	-	20.6	20.8	-
	-	23.0	22.6	21.8
	23.0	-	21.1	22.5
	21.5	22.4	22.2	22.3
	22.0	21.6	-	21.4
West Park	-	-	21.8	21.8
	23.6	21.9	22.6	22.9
	21.5	22.6	22.0	22.0
	22.7	21.6	21.4	21.8
	-	22.4	22.8	22.3
	22.8	22.5	22.5	22.9
	21.9	22.4	22.2	22.2
Tmt. Total	397.7	509.4	432.2	508.9
Tmt. Mean	22.09	22.15	21.92	22.13
No. Observations	18	23	22	23

APPENDIX TABLE 28(a)

The analysis of variance of the length of the pelvic bone (cm.) on Oct. 1, 1955 of the ewes (1952 trial) having received four different hoge wintering treatments

Source	d.f.	s.s.	m.s.	F
Total	85	43.35		
Between Winterings	3	0.72	0.24	-
Within Winterings	82	42.63	0.52	

APPENDIX TABLE 29

The length of pelvic bone (cm.) on Oct. 2, 1956 of B.F. ewes (1952 trial) having received four different hoggwintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	22.5	22.5	-	21.8
	-	22.3	21.8	22.0
	-	21.6	22.5	-
	21.9	22.5	-	-
	21.9	21.8	22.3	-
	-	22.6	23.2	-
	22.6	22.9	21.6	22.3
Howgate	22.2	21.4	-	-
	21.5	-	-	-
	-	22.0	-	-
	22.3	23.9	22.6	22.8
	-	-	22.2	20.3
	-	-	-	21.6
	-	-	20.6	22.3
Front	21.6	22.2	21.5	21.1
	21.1	21.9	-	22.4
	-	21.3	-	-
	-	-	23.1	21.9
	22.8	-	21.2	22.5
	21.8	22.3	-	22.2
	22.1	-	-	21.4
West Park	-	-	21.8	21.8
	24.1	22.0	22.8	22.8
	21.6	22.3	21.8	22.2
	22.5	21.6	21.3	22.0
	-	22.2	22.4	23.0
	22.2	22.3	22.3	23.0
	21.8	22.2	22.0	22.6
Tmt. Total	376.5	443.8	397.0	442.0
Tmt. Mean	22.15	22.19	22.05	22.10
No. Observations	17	20	18	20

APPENDIX TABLE 29(a)

The analysis of variance of the length of pelvic bone (cm.) on Oct. 2, 1956 of ewes (1952 trial) having received four different hoes wintering treatments

Source	d.f.	s.s.	m.s.	F
Total	74	29.92		
Between Winterings	3	0.19	0.063	-
Within Winterings	71	29.73	0.419	

APPENDIX TABLE 30

The length of the pelvic bone (cm.) on Sept. 12, 1957 of the ewes (1952 trial) having received four different hoggs wintering treatments

	Hill	Away	Inbye	Inbye ½
	22.4	22.3	-	22.2
	-	22.3	21.9	21.9
	-	21.1	-	-
Boghall	21.9	22.2	-	-
	22.0	21.6	22.8	-
	-	22.2	23.2	-
	22.2	22.7	21.9	22.4
	22.4	21.5	-	-
	21.6	-	-	-
	-	22.4	-	-
Howgate	-	24.1	22.3	23.0
	-	-	22.4	20.0
	-	-	-	22.2
	-	-	21.0	22.4
	21.8	22.3	21.7	22.3
	21.3	21.8	-	22.6
	-	20.8	-	-
Front	-	-	22.5	21.8
	22.4	-	21.5	22.3
	21.9	22.2	-	22.3
	21.6	-	-	21.2
	-	-	22.0	21.8
	24.4	22.1	22.8	23.4
	21.9	-	22.0	22.5
West Park	-	21.7	21.4	22.2
	-	22.8	22.4	22.6
	22.4	22.1	22.5	22.6
	21.9	22.4	22.2	22.5
Tmt. Total	332.1	420.6	376.5	444.2
Tmt. Mean	22.14	22.14	22.15	22.21
No. Observations	15	19	17	20

APPENDIX TABLE 31

The mean annual fleece weights (lb.) of the groups of ewes (1952 trial) having received four different hogg wintering treatments

Mean Fleece Weight		Hill	Away	Inbye	Inbye ½	Overall
Hoggs	June 1953	4.39	6.07	5.17	4.85	5.12
1st Crop	July 1954	5.59	5.60	5.71	5.60	5.63
2nd Crop	July 1955	4.79	4.79	5.07	5.15	4.94
3rd Crop	July 1956	4.87	4.78	4.66	4.50	4.69
4th Crop	July 1957	5.25	5.29	5.81	5.63	5.48

APPENDIX TABLE 32

The fleece weight (lb.) on June 22, 1953 of the ewe hoggs (1952 trial) having received four different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½
Boghall		5.2	5.2	4.7	4.7
		3.6	6.3	4.1	5.2
		4.5	5.9	4.8	4.4
		5.5	6.4	4.1	5.1
		5.6	7.4	7.0	5.2
		3.9	7.0	5.5	4.2
		4.5	5.5	6.4	5.0
	Heft Total	32.8	43.7	36.6	33.8
	" Mean	4.7	6.24	5.31	4.83
Howgate		3.9	8.2	4.7	7.2
		3.9	4.7	3.4	4.1
		4.2	4.7	4.8	5.7
		3.2	6.0	4.6	4.6
		3.7	6.4	4.3	4.4
		5.2	7.7	3.9	4.1
		3.6	5.0	4.2	5.0
	Heft Total	27.7	42.7	29.9	35.1
	" Mean	3.93	6.10	4.27	5.01
Front		4.5	6.2	6.1	5.0
		3.8	6.7	4.0	6.0
		3.9	6.7	4.0	3.9
		4.5	4.9	4.7	4.5
		3.9	5.7	6.3	4.7
		5.5	6.4	5.1	4.8
		4.7	6.1	5.7	5.0
	Heft Total	30.8	42.7	35.9	33.9
	" Mean	4.40	6.10	5.13	4.84
West Park		3.9	5.2	6.5	4.5
		5.8	6.7	5.3	4.7
		4.2	5.1	5.7	4.2
		3.9	5.2	6.3	3.6
		4.2	6.8	5.7	5.8
		3.5	5.7	7.0	4.4
		6.1	6.3	5.9	5.8
	Heft Total	31.6	41.0	42.4	33.0
	" Mean	4.51	5.86	6.06	4.71
Tmt. Total		122.9	170.1	144.8	135.8
Tmt. Mean		4.39	6.07	5.17	4.85

APPENDIX TABLE 32(a)

The analysis of variance of the fleece weight (lb.) in June 1953 of the ewe hoggs (1952 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	111	123.91				
Between Total Tmts.	15	56.69				
Winterings	3	42.60	14.2	12.03**	3.86	6.99
Hefts	3	3.48	1.15			
Heft x Wintering	9	10.61	1.18	1.68	1.92	2.59
Within Tmts.	96	67.22	0.70			
Comparisons:						
Winterings						
Away v. Inbye	1	11.43	11.43	9.69*	5.12	10.56
Inbye v. Inbye ½	1	1.45	1.45	1.23	5.12	10.56
Inbye v. Hill	1	8.56	8.56	7.25	5.12	10.56
Hill v. Inbye ½	1	2.97	2.97	2.52	5.12	10.56

** Significant at $P < .01$.
* Significant at $P < .05$.

APPENDIX TABLE 33

The weight of the fleece (lb.), in July 1954, of the ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	5.5	5.0	6.0	5.0
	-	5.5	5.5	6.0
	-	6.0	5.5	-
	-	5.0	5.0	6.0
	7.0	6.5	7.5	5.5
	4.0	6.0	6.0	4.5
	6.5	4.5	7.5	5.0
Howgate	3.0	6.0	5.0	6.5
	-	5.0	4.5	6.0
	6.0	4.5	6.0	5.5
	3.0	6.5	4.5	5.0
	4.0	6.0	6.5	6.5
	7.0	7.0	4.0	6.0
	-	-	5.0	5.0
Front	6.0	-	6.5	5.5
	6.0	6.0	4.5	6.0
	5.5	6.0	5.5	4.5
	-	4.0	5.5	4.5
	4.5	-	6.5	4.5
	5.5	6.0	5.0	5.5
	6.0	5.5	-	-
West Park	7.5	-	7.0	6.0
	5.5	5.5	5.0	7.0
	5.0	5.0	6.0	4.0
	6.5	5.0	7.0	5.5
	5.5	6.5	5.0	7.0
	5.5	5.5	6.5	6.5
	8.0	6.0	-	6.5
Tmt. Total	123.0	134.5	148.5	145.5
Tmt. Mean	5.6	5.60	5.71	5.60
No. Observations	22	34	26	26

APPENDIX TABLE 33(a)

The analysis of variance of the fleece weight (lb.) in July 1954 of the ewes (1952 trial) having received four different hoggg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	97	88.66				
Between Winterings	3	0.25	0.083	-	2.70	3.98
Within Winterings	94	88.41	0.94			

APPENDIX TABLE 34

The fleece weight (lb.), in July 1955, of the ewes (1952 trial) having received four different hoggwintering treatments

	Hill	Away	Inbye	Inbye ½
	-	5.0	5.0	-
	-	6.5	5.0	5.5
	-	6.0	5.5	-
Roghall	6.0	5.0	4.0	5.0
	4.5	6.0	6.5	-
	6.0	6.0	6.0	-
	-	8.0	8.5	6.0
	3.0	4.0	-	-
	3.0	3.5	-	-
	-	3.0	4.5	1.5
Howgate	3.0	2.5	3.0	-
	-	2.5	3.5	6.0
	-	-	-	-
	-	-	4.5	6.0
	7.5	3.0	6.0	5.5
	4.0	5.5	4.0	-
	5.0	5.0	4.0	4.5
Front	-	4.0	5.0	-
	3.0	-	6.0	5.0
	5.0	6.0	4.0	5.5
	5.0	5.0	-	-
	-	-	6.0	2.5
	4.5	2.5	6.0	6.5
	3.5	5.0	4.5	3.0
West [illegible]rk	5.5	5.0	5.5	7.0
	-	6.0	-	5.5
	6.0	5.0	4.5	6.5
	7.0	5.0	-	6.0
Tmt. Total	81.	115.0	111.5	87.5
Tmt. Mean	4.79	4.79	5.07	5.15
No. Observations	17	24	22	17

APPENDIX TABLE 34(a)

The analysis of variance of the fleece weight (lb.) in July 1955 of the ewes (1952 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	79	148.00				
Between Winterings	3	1.98	0.66	-	2.72	4.04
Within Winterings	76	146.02	1.92			

APPENDIX TABLE 35

The fleece weight (lb.), in July 1955, of the ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
	-	5.0	-	5.0
	-	6.5	3.5	3.5
	-	5.0	4.0	-
Boghall	5.0	4.0	3.0	-
	6.5	6.5	5.0	-
	4.0	3.5	5.0	-
	-	5.5	7.0	3.5
	3.0	5.5	-	-
	4.5	3.0	-	-
	-	-	-	-
Howgate	7.0	-	3.5	5.0
	-	-	4.5	6.0
	-	-	-	4.0
	-	-	5.0	3.5
	3.5	-	5.5	5.5
	5.0	4.5	-	5.5
	-	5.0	3.5	-
Front	-	-	4.5	3.0
	4.5	-	4.5	4.0
	7.5	5.5	6.0	4.0
	4.5	-	-	-
	-	-	4.5	-
	-	4.0	-	5.0
	2.5	3.5	-	4.5
West Park	5.0	4.5	6.0	5.0
	-	5.5	4.5	5.0
	4.5	5.0	5.5	4.5
	6.0	4.0	3.5	-
Tmt. Total	73.0	86.0	88.5	76.5
Tmt. Mean	4.87	4.78	4.66	4.50
No. Observations	15	18	19	17

APPENDIX TABLE 35(a)

The analysis of variance of the fleece weight (lb.) in July 1956 of the ewes (1952 trial) having received four different home wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	68	76.61				
Between Winterings	3	1.24	0.41	-	2.75	4.10
Within Winterings	65	75.37	1.16			

APPENDIX TABLE 36

The fleece weight (lb.), in July 1957, of the ewes (1952 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	4.5	4.5	-	5.0
	-	-	5.0	5.5
	-	5.5	-	-
	-	5.0	-	-
	6.0	-	-	-
	-	6.5	-	-
	-	4.5	5.5	-
Howgate	4.0	7.0	-	-
	4.0	-	-	-
	-	4.0	-	-
	-	4.5	5.0	4.5
	-	-	4.5	5.5
	-	-	-	7.0
	-	-	5.5	-
Front	6.0	5.0	7.0	6.0
	-	7.0	-	4.5
	5.5	6.0	-	-
	6.0	-	5.5	4.0
	4.0	-	-	5.0
	5.5	5.5	-	5.5
	5.0	-	-	-
West Park	-	-	5.5	-
	7.0	6.0	7.5	7.0
	5.0	4.0	6.0	-
	-	5.0	5.5	6.5
	-	-	-	6.5
	6.5	5.0	6.0	5.0
	4.5	5.0	7.0	7.0
Tmt. Total	73.5	90.0	75.5	84.5
Tmt. Mean	5.25	5.29	5.81	5.63
No. Observations	14	17	13	15

APPENDIX TABLE 36(a)

The analysis of variance of the fleece weight (lb.) in July 1957 of the ewes (1952 trial) having received four different hoggwintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	58	52.49				
Between Winterings	3	3.07	1.02	1.13	2.78	4.16
Within Winterings	55	49.42	0.898			

APPENDIX TABLE 37

The frequency and distribution of barren* ewes (1952 trial) expressed as a fraction of the number of possible observations

		Hill	Away	Inbye	Inbye ⅓	Heft Total
1954	Boghall	1/6	1/7	0/7	1/6	3/26
	Howgate	0/6	1/7	0/7	2/7	3/27
	Front	0/6	1/6	0/6	1/7	2/25
	West Park	2/7	0/7	0/7	2/7	4/28
Year Total		3/25	3/27	0/27	6/27	12/106
1955	Boghall	1/5	1/6	0/7	1/5	3/23
	Howgate	0/3	2/7	2/4	0/6	4/20
	Front	1/6	0/6	0/5	0/7	1/24
	West Park	0/6	0/5	0/6	1/6	1/23
Year Total		2/20	3/24	2/22	2/24	9/90
1956	Boghall	0/5	1/7	0/7	0/5	1/24
	Howgate	0/3	0/4	2/4	1/4	3/15
	Front	0/5	1/4	0/5	0/6	1/20
	West Park	0/5	0/6	0/7	0/7	0/25
Year Total		0/18	2/21	2/23	1/22	5/84
1957	Boghall	0/3	0/5	0/4	0/3	0/15
	Howgate	0/2	0/3	0/3	0/4	0/12
	Front	0/5	0/4	0/3	1/6	1/18
	West Park	0/4	1/6	0/7	0/6	1/23
Year Total		0/14	1/18	0/17	1/19	2/68
Lifetime Tmt. Total		5/77	9/90	4/89	10/92	27/348

APPENDIX TABLE 37(a)

The analysis of variance of the percentage of barrenness of the groups of ewes (1952 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	15	501.6				
Winterings	3	98.12	32.71	6.12	3.86	6.99
Years	3	188.40	62.80	2.31	3.86	6.99
Year x Wintering	9	245.10	27.23			
Comparison:						
Years						
1954 & 1955 v. 1956 & 1957	1	166.8	166.8	6.12*	5.12	10.56

* Significant at $P < .05$.

APPENDIX TABLE 38

The annual frequency and distribution of twin lambs (expressed as a fraction of the number of possible observations) born to the groups of ewes (1952 trial) having received four different hogg wintering treatments

		Hill	Away	Inbye	Inbye ½	Heft Total
1954	Boghall	0/6	3/7	0/7	1/6	4/26
	Howgate	0/6	2/7	1/7	1/7	4/27
	Front	0/6	1/6	1/6	0/7	2/25
	West Park	1/7	2/7	3/7	1/7	7/28
Year Total		1/25	8/27	5/27	3/27	17/100
1955	Boghall	1/5	0/6	0/7	0/5	1/23
	Howgate	2/3	1/7	0/4	0/6	3/20
	Front	0/6	0/6	0/5	0/7	0/24
	West Park	1/6	1/5	2/7	1/6	5/24
Year Total		4/20	2/24	2/23	1/24	9/91
1956	Boghall	1/5	0/7	2/7	1/5	4/24
	Howgate	1/3	0/4	1/4	1/4	3/15
	Front	0/5	0/4	1/4	2/6	3/19
	West Park	3/5	1/5	2/6	1/7	7/23
Year Total		5/18	1/20	6/21	5/22	17/81
1957	Boghall	1/3	3/5	0/4	1/3	5/15
	Howgate	1/2	2/3	0/3	2/4	5/12
	Front	2/5	3/4	3/3	1/5	9/17
	West Park	2/4	3/6	3/7	1/6	9/23
Year Total		6/14	11/18	6/17	5/18	28/67
Lifetime Tmt. Total		16/77	22/89	19/88	14/91	71/345

APPENDIX TABLE 38(a)

The analysis of variance of the percentage of ewes bearing twins of the groups of ewes (1952 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	15	3,741.66				
Winterings	3	199.59	66.53	-	5.12	10.56
Years	3	2,273.56	757.85	5.37*	5.12	10.56
Year x Wintering	9	1,268.51	140.94			

* Significant at $P < .05$.

APPENDIX TABLE 39

The adjusted* birth weight (lb.) of lambs born to the ewes (1952 trial) in the first production year, 1954 having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	14.0	12.2	11.8	9.0
	11.8	11.5	9.8	8.2
	-	11.3	8.2	-
	11.0	10.7	8.2	7.2
	9.2	11.7	11.0	13.0
	-	10.0	10.0	10.7
	10.0	-	10.2	10.8
Howgate	12.0	12.0	9.2	10.0
	10.8	10.8	8.2	-
	4.2	11.5	10.2	-
	7.0	10.4	11.2	9.4
	9.0	12.0	9.5	9.5
	7.5	9.5	11.0	10.8
	-	-	13.0	10.8
Front	11.5	12.2	9.8	12.0
	11.2	11.2	12.5	-
	13.8	11.0	10.0	10.0
	-	-	11.2	12.0
	9.0	-	12.0	13.2
	13.8	10.0	9.2	-
	11.5	11.2	-	12.5
West Park	9.0	9.4	10.0	8.5
	11.9	13.2	10.0	11.2
	12.2	13.5	11.0	10.4
	11.0	10.0	10.0	-
	11.2	13.8	11.2	12.2
	-	10.4	11.7	-
	-	9.8	11.8	7.0
Tmt. Total	231.4	269.3	281.9	218.4
Tmt. Mean	10.5	11.2	10.4	10.4
No. Observations	22	24	27	21

* Adjusted for type of birth and sex.

APPENDIX TABLE 39(a)

The analysis of variance of the adjusted* birth weight (lb.) of lambs born to the ewes (1952 trial) in their first production year, 1954, having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	93	259.86				
Between Winterings	3	10.70	3.57	1.29	2.72	4.04
Within Winterings	90	249.16	2.77			

* Adjusted for type of birth and sex.

APPENDIX TABLE 40

The adjusted* birth weight (lb.) of lambs born to the ewes (1952 trial) in the second production year, 1955 having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
	-	6.7	8.0	-
	-	7.2	6.0	6.0
	-	10.7	7.7	-
Boghall	8.0	4.7	8.0	7.0
	9.7	7.5	7.5	-
	6.5	-	7.5	-
	7.5	-	10.5	10.7
	9.0	6.2	-	-
	10.3	7.8	-	8.5
	-	8.5	7.5	6.0
Howgate	8.0	-	-	10.2
	-	8.0	-	8.5
	-	6.0	-	7.2
	-	-	10.0	10.7
	7.0	8.7	7.7	9.7
	9.0	8.0	10.0	-
	8.5	8.0	7.7	7.7
Front	-	7.2	8.7	8.2
	-	-	7.2	8.5
	-	10.0	-	9.7
	9.0	7.0	-	9.2
	-	-	7.7	4.0
	8.7	8.7	5.0	-
	6.0	7.5	10.0	7.0
West Park	8.5	-	6.7	-
	6.7	9.5	9.3	6.7
	8.5	8.0	7.5	5.7
	7.3	7.5	-	6.7
Tmt. Total	138.2	163.4	160.2	157.9
Tmt. Mean	8.1	7.8	8.0	7.9
No. Observations	17	21	20	20

* Adjusted for type of birth and sex.

APPENDIX TABLE 40(a)

The analysis of variance of the adjusted* birth weight (lb.) of lambs born to the ewes (1952 trial) in their second production year, 1955, having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	77	159.47				
Between Winterings	3	1.27	0.42	-	2.74	4.08
Within Winterings	74	158.20	2.14			

* Adjusted for type of birth and sex.

APPENDIX TABLE 41

The adjusted* birth weight (lb.) of lambs born to the ewes (1952 trial) in the third production year, 1956 having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	4.9	12.8	6.5	11.5
	-	7.5	5.5	7.8
	-	10.3	9.0	-
	8.3	7.8	10.0	6.5
	7.5	7.8	8.2	9.0
	5.5	-	10.5	-
	8.8	10.3	11.8	9.4
Howgate	5.7	6.5	-	-
	9.8	4.5	-	-
	-	10.0	-	-
	8.8	9.3	9.4	7.0
	-	-	10.0	-
	-	-	-	8.0
	-	-	10.3	9.6
Front	8.5	8.3	12.0	13.5
	9.5	5.0	-	5.8
	-	-	9.3	-
	-	-	10.5	8.8
	10.3	-	9.1	12.5
	8.3	9.8	-	-
	7.3	-	-	10.2
West Park	-	-	7.5	5.3
	9.6	6.8	-	6.8
	9.0	9.0	9.3	12.0
	9.3	7.0	8.5	4.8
	-	8.5	9.9	10.5
	8.3	8.0	8.8	8.5
	7.0	5.9	8.3	9.2
Tmt. Total	146.4	155.1	184.4	176.7
Tmt. Mean	8.1	8.2	9.2	8.8
No. Observations	18	19	20	20

* Adjusted for type of birth and sex.

APPENDIX TABLE 41(a)

The analysis of variance of the adjusted* birth weight (lb.) of lambs born to the ewes (1952 trial) in their third production year, 1956, having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	76	289.04				
Between Winterings	3	16.32	5.44	1.46	2.74	4.08
Within Winterings	73	272.72	3.73			

* Adjusted for type of birth and sex.

APPENDIX TABLE 42

The adjusted* birth weight (lb.) of lambs born to the ewes (1952 trial) in the fourth production year, 1957 having received four different hoggg wintering treatments

	Hill	Away	Inbye	Inbye ½
	10.0	8.6	-	10.0
	-	-	7.0	-
	-	12.0	-	-
Boghall	-	10.3	-	8.4
	10.5	8.3	9.4	-
	-	-	10.0	-
	12.4	11.9	9.0	12.4
	9.7	10.4	-	-
	10.0	-	-	-
	-	9.5	-	-
Howgate	-	8.8	7.5	9.7
	-	-	10.0	12.0
	-	-	-	10.7
	-	-	11.0	12.4
	9.0	10.5	9.2	9.5
	9.0	8.0	-	-
	-	8.9	-	-
Front	-	-	10.2	7.4
	9.4	-	8.9	9.5
	11.5	9.5	-	10.0
	10.4	-	-	10.8
	-	-	10.4	-
	10.7	6.4	9.0	-
	-	9.9	10.4	10.0
West Park	8.8	9.2	8.8	7.4
	-	7.0	8.5	9.8
	11.0	8.5	10.4	8.9
	7.4	-	8.4	11.0
Tmt. Total	139.8	157.7	158.1	169.9
Tmt. Mean	10.0	9.3	9.3	10.0
No. Observations	14	17	17	17

* Adjusted for type of birth and sex.

APPENDIX TABLE 42(a)

The analysis of variance of the adjusted[a] birth weight (lb.) of the lambs born to the ewes (1952 trial) in their fourth production year, 1957, having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	64	119.10				
Between Winterings	3	7.90	2.63	1.44	2.76	4.13
Within Winterings	61	111.20	1.82			
Comparison:						
Winterings						
Away & Inbye v. Hill & Inbye ½	1	7.90	7.90	4.34*	4.00	7.08

[a] Adjusted for type of birth and sex.
* Significant at $P < .05$.

APPENDIX TABLE 43

The adjusted* daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1952 trial), in their first production year, 1954 having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	.409	.322	.415	-
	.323	.379	-	.450
	-	.363	.416	-
	.450	-	-	.399
	.380	.365	.463	.401
	-	.353	.343	-
	.400	-	.430	-
Howgate	-	.434	-	.459
	-	.373	-	-
	.311	.388	.539	-
	.393	-	.363	.460
	.457	-	.364	.326
	.334	.419	.398	.478
	-	.415	.436	-
Front	-	.325	.340	-
	.382	.415	.446	-
	.550	-	.389	.326
	-	-	.495	.422
	.386	.392	.480	.440
	.432	.362	-	-
	.370	.516	-	.463
West Park	.415	.398	.438	.367
	-	.458	.424	.379
	.432	-	.442	.349
	.563	.456	.441	-
	.452	.452	.417	.514
	-	.547	.398	-
	-	.352	.411	.432
Tmt. Total	7.439	8.484	9.288	6.665
Tmt. Mean	.413	.404	.422	.416
No. Observations	18	21	22	16

* Adjusted for type of birth and sex.

APPENDIX TABLE 43(a)

The analysis of variance of the adjusted[a] daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1952 trial), in their first production year, 1954 having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	76	.242648				
Between Winterings	3	.003693	.001231	-	2.74	4.08
Within Winterings	73	.238955	.003273			

[a] Adjusted for type of birth and sex.

APPENDIX TABLE 44

The adjusted* daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1952 trial) in their second production year, 1955 having received four different home wintering treatments

	Hill	Away	Inbye	Inbye ½
	-	.453	.569	-
	-	.502	-	.500
	-	.453	.530	-
Boghall	.474	-	.545	.540
	-	.443	-	-
	.469	-	.375	-
	-	-	.588	.419
	.584	.482	-	-
	.496	.420	-	-
	-	.431	.500	.377
Howgate	-	.477	-	.533
	.521	-	-	.476
	-	-	-	.547
	-	.333	.492	.419
	.538	.543	.539	.557
	.586	.444	-	-
	-	.474	.443	.544
Front	-	.458	.533	-
	.465	-	.406	.514
	-	-	-	.571
	.491	.464	-	.525
	.618	.504	.518	.441
	-	.496	.546	-
	.539	.520	.522	-
West Park	.450	.608	-	-
	.392	.611	.520	.648
	.628	.470	.463	.455
	.421	-	.524	.547
Tmt. Total	7.672	9.586	8.612	8.613
Tmt. Mean	.511	.479	.507	.507
No. Observations	15	20	17	17

* Adjusted for type of birth and sex.

APPENDIX TABLE 44(a)

The analysis of variance of the adjusted[a] daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1952 trial), in their second production year, 1955 having received four different hoggwintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	68	.278629				
Between Winterings	3	.012026	.004009	-	2.75	4.10
Within Winterings	65	.266603	.004102			

[a] Adjusted for type of birth and sex.

APPENDIX TABLE 45

The adjusted* daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1952 trial) in their third production year, 1956 having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	.538	.371	.428	.550
	.497	.478	.481	.452
	-	-	.416	.428
	.408	.454	.393	.391
	.422	.348	.404	-
	.467	-	.459	.471
	-	.497	.592	.525
Howgate	.430	.563	-	-
	.498	.461	-	-
	.496	.430	-	.514
	-	.642	.441	-
	.542	-	.383	.513
	-	-	.534	.471
	-	-	.403	.525
Front	.491	.599	.509	.641
	.402	.481	-	.435
	-	-	.462	.503
	-	-	.491	.467
	.528	-	.423	.481
	-	-	.502	.413
	.450	-	.449	.442
West Park	.511	.538	.588	.527
	.521	.468	.520	.559
	.529	.524	.471	.510
	.568	.519	.512	.649
	.493	.567	.513	.500
	.493	.468	.540	.604
	.480	.397	.554	.632
Tmt. Total	9.764	9.005	11.468	12.153
Tmt. Mean	.488	.500	.478	.506
No. Observations	20	18	24	24

* Adjusted for type of birth and sex.

APPENDIX TABLE 45(a)

The analysis of variance of the adjusted[a] daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1952 trial), in their third production year, 1956 having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	85	.338953				
Between Winterings	3	.011227	.003742	-	2.72	4.04
Within Winterings	82	.327726	.003996			

[a] Adjusted for type of birth and sex.

APPENDIX TABLE 46

The adjusted* daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1952 trial) in their fourth production year, 1957 having received four different hogg wintering treatments

	Hill	Away	Inbye	Inbye ½
Boghall	.568	.534	.542	.581
	.579	.583	-	-
	-	.517	-	.495
	-	.537	.644	-
	.604	.508	.555	-
	-	.593	.487	-
	.550	.561	-	.532
Howgate	.565	.499	.569	-
	.640	.705	-	-
	-	.550	-	-
	.623	.583	.557	.525
	-	.624	.566	.611
	-	.666	-	.624
	-	-	.606	.532
Front	.581	.533	.695	.596
	.492	.560	.659	-
	.501	.653	.568	.486
	.628	.513	.553	.561
	.682	.623	.565	.500
	.535	.694	.534	.632
	.414	.686	.562	.562
West Park	.599	.601	.607	-
	.744	.544	.605	.588
	.590	.642	.551	.594
	.533	.588	.570	-
	-	.704	.607	.641
	.599	-	.507	.559
	.612	.654	.626	-
Tmt. Total	11.639	15.455	12.735	9.619
Tmt. Mean	.582	.594	.579	.566
No. Observations	20	26	22	17

* Adjusted for type of birth and sex.

APPENDIX TABLE 46(a)

The analysis of variance of the adjusted[a] daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1952 trial), in their fourth production year, 1957 having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	84	.296220				
Between Winterings	3	.008637	.002879	-	2.72	4.04
Within Winterings	81	.287583	.00355			

[a] Adjusted for type of birth and sex.

APPENDIX TABLE 47

The production years that the ewes (1952 trial) remained in the flock (as a fraction of the possible)

	Hill	Away	Inbye	Inbye ½
Boghall	4/4	4/4	3/3	4/4
	1/1	4/4	4/4	4/4
	0/4	4/4	3/4	0/4
	3/3	4/4	3/3	4/4
	4/4	4/4	4/4	3/3
	3/3	4/4	4/4	1/4
	4/4	4/4	4/4	4/4
Heft Total	19/23	28/28	25/26	20/27
Howgate	4/4	4/4	1/4	1/4
	4/4	3/4	3/4	2/4
	1/4	4/4	2/4	2/4
	3/4	4/4	4/4	4/4
	1/4	2/4	4/4	4/4
	1/4	2/2	1/4	4/4
	0/4	2/4	4/4	4/4
Heft Total	14/28	21/26	19/28	21/28
Front	4/4	4/4	4/4	4/4
	4/4	4/4	2/2	4/4
	2/4	4/4	3/3	2/4
	0/4	2/4	4/4	4/4
	4/4	0/4	4/4	4/4
	4/4	4/4	3/3	4/4
	4/4	2/4	0/4	4/4
Heft Total	22/28	20/28	20/24	26/28
West Park	1/4	1/4	4/4	3/4
	4/4	4/4	4/4	4/4
	3/3	4/4	4/4	4/4
	4/4	4/4	4/4	4/4
	2/4	4/4	4/4	4/4
	4/4	4/4	4/4	4/4
	4/4	4/4	4/4	4/4
Heft Total	22/27	25/28	28/28	27/28
Tmt. Total	77/106	94/110	92/106	94/111

APPENDIX TABLE 47(a)

The analysis of variance of the percentage production years that the ewes (1952 trial) remained in the flock having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	15	2,687.84				
Winterings	3	472.93	157.64	1.51	3.86	6.99
Hefts	3	1,276.10	425.40	4.08*	3.86	6.99
Heft x Wintering	9	938.81	104.31			
Comparison:						
Hefts						
Howgate v. Rest	1	1,058.4	1,058.4	10.14*	5.12	10.56

* Significant at $P < .05$.

APPENDIX TABLE 48

The mean body weight (lb.) at various stages of development of the groups of B.F. sheep (1953 trial) given four different hogg wintering treatments

		Hill	Away	Inbye	Away ½	Overall
Initial wt.	1/10/53	67.3	65.5	65.3	69.1	66.8
Mean wt. at	7/1/54	64.7	79.9	65.4	83.9	73.5
" " "	1/4/54	54.2	75.2	52.8	63.2	61.4
" " "	16/6/54	76.2	87.4	75.5	85.3	81.1
" " "	6/10/54	96.8	100.7	96.3	104.2	99.5
" " "	1/10/55	99.7	99.7	98.4	104.0	100.5
" " "	2/10/56	107.8	104.5	103.8	109.2	106.3
" " "	1/10/57	121.3	120.2	118.4	125.9	121.6

APPENDIX TABLE 49

The body weight (lb.) of the ewe hoggs (1953 trial) on Oct. 1, 1953, at the start of four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	66	64	66	68
	71	65	66	70
	57	69	62	60
	62	66	71	75
	62	66	64	60
	66	65	63	79
Heft Total	384	395	392	412
" Mean	64.0	65.8	65.3	68.7
Howgate	70	68	66	70
	64	68	68	62
	77	66	79	68
	67	66	59	54
	68	64	67	69
	68	55	62	62
Heft Total	414	387	401	385
" Mean	69.0	64.5	66.8	64.2
Front	74	62	60	80
	72	66	62	80
	64	65	60	78
	71	73	63	68
	72	67	64	76
	62	71	67	64
Heft Total	415	404	376	446
" Mean	69.1	67.3	62.7	74.3
West Park	80	63	67	64
	69	62	70	83
	62	76	65	77
	66	68	63	64
	63	58	76	60
	63	60	57	67
Heft Total	403	386	398	415
" Mean	67.1	64.3	66.3	69.1
Tmt. Total	1,616	1,572	1,567	1,658
Tmt. Mean	67.3	65.5	65.3	69.1

APPENDIX TABLE 49(a)

The analysis of variance of the body weight (lb.) of ewe hoggs (1953 trial) on Oct. 1, 1953, at the start of the four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	95	3,371				
Between Total Tmts.	15	738				
Winterings	3	227	75.6	1.60	3.86	6.99
Hefts	3	87	29.0	-		
Heft x Wintering	9	424	47.1	1.43	1.99	2.64
Within Tmts.	80	2,633	32.9			

APPENDIX TABLE 50

The body weight (lb.) of the ewe hoggs (1953 trial) on Jan. 7, 1954, midway through four different hogg wintering treatments

		Hill	Away	Inbye	Away ½
Boghall		61	77	64	77
		66	69	64	83
		56	80	63	78
		58	81	70	87
		60	79	64	74
		62	78	63	87
	Heft Total	363	464	388	486
	" Mean	60.5	77.3	64.7	81.0
Howgate		66	87	67	83
		60	84	66	78
		73	79	77	84
		64	80	62	69
		68	77	64	86
		64	84	65	82
	Heft Total	395	491	401	482
	" Mean	65.8	81.8	66.8	80.3
Front		70	72	58	99
		68	76	60	104
		63	82	56	95
		72	87	64	79
		72	82	60	88
		60	85	70	86
	Heft Total	405	484	368	551
	" Mean	67.5	80.7	61.3	91.8
West Park		76	78	72	82
		70	77	78	87
		56	84	63	99
		62	86	61	71
		67	74	77	73
		60	80	61	84
	Heft Total	391	479	412	496
	" Mean	65.1	79.8	68.7	82.7
Tmt. Total		1,554	1,918	1,569	2,015
Tmt. Mean		64.7	79.9	65.4	83.9

APPENDIX TABLE 50(a)

The analysis of variance of the body weight (lb.) of ewe hoggs (1953 trial) on Jan. 7, 1954, midway through the four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	95	10,820				
Between Total Tmts.	15	7,954				
Winterings	3	7,034	2,344.6	46.6**	3.86	6.99
Hefts	3	225	75.0	1.0		
Heft x Wintering	9	665	73.9	2.06*	1.99	2.64
Within Tmts.	80	2,866	35.8			
Comparison:						
Winterings						
Hill & Inbye v. Away & Away ½	1	6,834	6,834	92.5**	5.12	10.56

** Significant at $P < .01$.
* Significant at $P < .05$.

APPENDIX TABLE 51

The body weight (lb.) of the ewe hoggs (1953 trial) on April 1, 1954, at the end of four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	55	72	56	60
	53	74	52	68
	47	68	51	54
	48	70	57	67
	53	72	51	59
	55	74	52	66
Heft Total	313	430	319	374
" Mean	52.2	71.7	53.1	62.3
Howgate	56	81	52	60
	45	75	54	56
	63	76	64	60
	51	78	49	50
	52	71	59	60
	56	66	50	60
Heft Total	323	447	328	346
" Mean	53.8	74.5	54.7	57.7
Front	60	68	46	75
	59	78	57	76
	52	81	45	74
	57	79	46	62
	62	80	51	65
	46	82	53	59
Heft Total	336	468	298	411
" Mean	56.0	78.0	49.7	68.5
West Park	61	74	39	68
	64	78	55	78
	57	79	51	66
	54	83	51	58
	46	71	60	56
	48	75	47	61
Heft Total	330	460	323	387
" Mean	55.0	76.7	53.8	64.5
Tmt. Total	1,302	1,805	1,268	1,518
Tmt. Mean	54.2	75.2	52.8	63.2

APPENDIX TABLE 51(a)

The analysis of variance of the body weight (lb.) of the ewe hoggs (1953 trial) on April 1, 1954, at the end of the four hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	95	10,613				
Between Total Tmts.	15	8,287				
Winterings	3	7,646	2,549	50.8 **	3.86	6.99
Hefts	3	189	63	1.26		
Heft x Wintering	9	452	502	1.72	1.99	2.64
Within Tmts.	80	2,326	29.1			
Comparison:						
Winterings						
Away v. Away ½	1	1,716	1,716	34.2 **	5.12	10.56
Hill v. Away ½	1	971	971	19.34**	5.12	10.56

** Significant at P <.01.
* Significant at P <.05.

APPENDIX TABLE 52

The body weight (lb.) on June 16, 1954 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

		Hill	Away	Inbye	Away ½
Boghall		69	84	76	81
		61	81	74	85
		67	82	74	75
		64	84	80	89
		68	85	74	66
		76	89	66	84
	Heft Total	405	505	444	480
	" Mean	67.5	84.2	74.0	80.0
Howgate		80	95	71	85
		65	91	83	79
		86	92	87	82
		72	89	79	73
		80	86	80	85
		77	74	74	84
	Heft Total	460	527	474	488
	" Mean	76.7	87.8	79.0	81.3
Front		89	78	56	100
		88	84	74	104
		77	96	66	100
		88	90	80	90
		89	98	70	96
		66	97	68	80
	Heft Total	497	543	414	570
	" Mean	82.8	90.5	69.0	95.0
West Park		86	82	83	88
		90	84	85	96
		72	94	82	84
		80	91	78	78
		70	84	85	79
		70	88	68	85
	Heft Total	468	523	481	510
	" Mean	78.0	87.1	80.1	85.0
Tmt. Total		1,830	2,098	1,813	2,048
Tmt. Mean		76.2	87.4	75.5	85.3

APPENDIX TABLE 52(a)

The analysis of variance of the body weight (lb.) on June 16, 1954 of ewe hoggs (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	95	8,685				
Between Total Tmts.	15	6,196				
Winterings	3	2,692	897.3	3.02	3.86	6.99
Hefts	3	830	276.7			
Heft x Wintering	9	2,674	297.1	9.5 **	1.99	2.64
Within Tmts.	80	2,489	31.1			
Comparison:						
Wintering						
Hill & Inbye v. Away & Away ½	1	2,635	2,635	8.87*	5.12	10.56

** Significant at $P < .01$.
* Significant at $P < .05$.

APPENDIX TABLE 53

The body weight (lb.) on Oct. 6, 1954 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

		Hill	Away	Inbye	Away ½
Boghall		91	99	101	100
		78	92	96	113
		86	100	93	98
		84	104	101	109
		93	95	103	83
		93	103	77	103
	Heft Total	525	593	571	606
	" Mean	87.5	98.8	95.2	101
Howgate		103	116	97	112
		88	109	104	102
		112	104	114	108
		94	114	78	91
		107	102	105	108
		97	78	104	100
	Heft Total	601	623	602	621
	" Mean	100.2	103.8	100.3	103.5
Front		112	89	81	111
		102	87	100	123
		96	107	88	118
		108	103	103	108
		105	109	96	113
		83	106	85	94
	Heft Total	606	601	553	667
	" Mean	101	100.2	92.2	111.2
West Park		104	96	99	101
		112	92	99	112
		93	110	96	99
		97	104	89	96
		95	97	105	95
		90	102	98	103
	Heft Total	591	601	586	606
	" Mean	98.5	100.2	97.7	101
Tmt. Total		2,323	2,418	2,312	2,500
Tmt. Mean		96.8	100.7	96.3	104.2

APPENDIX TABLE 53(a)

The analysis of variance of the body weight (lb.) on Oct. 6, 1954 of ewe hoggs (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	95	8,817				
Between Total Tmts.	15	2,404				
Winterings	3	977	326	3.42	3.86	6.99
Hefts	3	569	187	1.96	3.86	6.99
Heft x Wintering	9	858	95.3	1.19	1.99	2.64
Within Tmts.	80	6,413	80.2			
Comparison:						
Winterings						
Hill & Inbye v. Away & Away ½	1	834	834	8.75*	5.12	10.56
Away ½ v. Away	1	540	540	5.66	5.12	10.56
Away v. Inbye	1	234	234	2.45	5.12	10.56
Hefts						
Boghall v. Others	1	483	483	5.07	5.12	10.56

* Significant at $P < .05$.

APPENDIX TABLE 54

The body weight (lb.) on Oct. 1, 1955 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	104	91	96	103
	86	91	108	107
	92	106	96	96
	100	98	104	97
	99	-	104	88
	-	105	84	116
Howgate	105	104	94	99
	-	105	112	101
	112	100	112	98
	84	100	102	100
	112	105	98	104
	95	86	99	104
Front	111	97	-	110
	83	84	94	112
	108	-	92	116
	-	99	100	102
	111	105	90	113
	87	99	97	107
West Park	-	100	102	103
	114	94	94	108
	97	109	98	118
	98	106	89	104
	100	98	109	88
	96	111	90	102
Tmt. Total	1,994	2,193	2,264	2,496
Tmt. Mean	99.7	99.7	98.4	104.0
No. Observations	20	22	23	24

APPENDIX TABLE 54(a)

The analysis of variance of the body weight (lb.) on Oct. 1, 1955 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	88	5,970				
Between Winterings	3	419	139.7	2.14	2.72	4.04
Within Winterings	85	5,551	65.3			
Comparison:						
Away $\frac{1}{2}$ v. Rest	1	395	395	6.05*	3.96	6.96

* Significant at $P < .05$.

APPENDIX TABLE 55

The body weight (lb.) on Oct. 2, 1956 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	-	99	106	102
	96	96	106	114
	96	108	102	102
	104	103	114	-
	110	117	107	98
	102	110	-	112
Howgate	109	107	103	101
	-	110	-	92
	117	102	115	106
	91	106	109	-
	112	102	106	104
	112	-	90	112
Front	121	106	-	126
	102	92	-	124
	-	116	96	116
	-	100	-	114
	-	105	102	120
	-	100	104	96
West Park	-	104	94	110
	121	98	100	118
	106	106	101	110
	113	96	-	110
	110	109	112	96
	110	112	101	110
Tmt. Total	1,832	2,404	1,868	2,403
Tmt. Mean	107.8	104.5	103.8	109.2
No. Observations	17	23	18	22

APPENDIX TABLE 55(a)

The analysis of variance of the body weight (lb.) on Oct. 2, 1956 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	79	4,746				
Between Winterings	3	411	137	2.403	2.72	4.04
Within Winterings	76	4,335	57.0			
Comparison:						
Away ½ v. Rest	1	253	253	4.44*	3.96	6.96
Away ½ v. Hill	1	21	21			

* Significant at $P < .05$.

APPENDIX TABLE 56

The body weight (lb.) on Oct. 7, 1957 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	-	110	111	-
	107	107	-	124
	112	120	110	128
	122	121	132	-
	118	146	117	116
	122	124	-	130
Howgate	115	-	122	-
	-	129	-	-
	136	130	138	124
	110	129	110	-
	140	115	-	124
	128	-	118	133
Front	137	111	-	136
	88	113	-	142
	133	135	-	128
	-	120	-	-
	-	119	115	128
	-	115	118	122
West Park	124	106	-	126
	-	97	112	130
	-	134	112	128
	126	119	-	119
	122	124	125	106
	123	121	117	122
Tmt. Total	2,063	2,645	1,657	2,266
Tmt. Mean	121.3	120.2	118.4	125.9
No. Observations	17	22	14	18

APPENDIX TABLE 56(a)

The analysis of variance of the body weight (lb.) on Oct. 2, 1956 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	70	7,660				
Between Winterings	3	521	173.7	1.63	2.75	4.10
Within Winterings	67	7,139	106.5			
Comparison:						
Away $\frac{1}{2}$ v. Rest	1	451	451	4.23*	3.99	7.04

* Significant at $P < .05$.

APPENDIX TABLE 57

The changes in body weight (lb.) from October 1954 - October 1955 of the ewes (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	+ 13	- 8	- 5	+ 3
	+ 8	- 1	+ 12	- 6
	+ 6	+ 6	+ 3	- 2
	+ 16	- 6	+ 3	- 12
	+ 6	-	+ 1	+ 5
	-	+ 2	+ 7	+ 13
Heft Mean	+ 9.8	- 1.4	+ 3.5	+ 0.2
Howgate	+ 2	- 12	- 3	- 13
	-	- 4	+ 8	- 1
	0	- 4	- 2	- 10
	- 10	- 14	+ 24	+ 9
	+ 5	+ 3	- 7	- 4
	- 2	+ 8	- 5	+ 4
Heft Mean	- 1.0	- 3.9	+ 2.5	- 2.5
Front	- 1	+ 8	-	- 1
	- 19	- 3	- 6	- 11
	+ 12	-	+ 4	- 2
	-	- 4	- 3	- 6
	+ 6	- 4	- 6	0
	+ 4	- 7	+ 12	+ 13
Heft Mean	+ 0.4	- 2.0	+ 0.2	- 1.1
West Park	-	+ 4	+ 3	+ 2
	+ 2	+ 2	- 5	- 4
	+ 4	- 1	+ 2	+ 19
	+ 1	+ 2	0	+ 8
	+ 5	+ 1	+ 4	- 7
	+ 6	+ 9	- 8	- 1
Heft Mean	+ 3.6	+ 2.9	- 1.0	+ 2.9
Tmt. Total	+ 64	- 23	+ 31	- 4.0
Tmt. Mean	+ 3.2	- 1.0	+ 1.3	- 0.2
No. Observations	20	22	23	24

APPENDIX TABLE 57(a)

The analysis of variance of the changes in body weight (lb.) from October 1954 - October 1955 of the ewes (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F
Total	68	5,033		-
Between Winterings	3	205	68.1	
Within Winterings	65	4,828	74.2	

APPENDIX TABLE 58

The mean annual fleece weights (lb.) of the groups of ewes (1953 trial) having received four different hogg wintering treatments

Mean Fleece Weight		Hill	Away	Inbye	Away ½	Overall
Hoggs	June 1954	4.59	6.51	4.81	5.90	5.45
1st Crop	July 1955	4.79	5.23	4.69	4.91	4.92
2nd Crop	July 1956	4.55	4.87	4.34	4.60	4.61
3rd Crop	July 1957	4.89	5.45	5.32	5.62	5.36
4th Crop	July 1958	4.65	5.56	4.98	5.03	5.11

APPENDIX TABLE 59

The fleece weight (lb.) on June 16, 1954 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	5.2	7.0	5.5	6.2
	4.0	6.5	5.2	6.8
	5.5	6.0	4.5	5.5
	3.5	8.0	4.5	6.0
	3.8	5.0	5.0	6.4
	5.8	7.0	5.5	7.0
Heft Total	27.8	39.5	30.2	37.9
" Mean	4.63	6.58	5.04	6.32
Howgate	5.5	6.0	4.2	5.5
	5.5	5.5	3.5	4.5
	3.5	6.5	5.0	5.0
	4.2	6.5	4.0	5.5
	3.5	6.8	3.8	5.0
	3.8	6.5	4.2	5.2
Heft Total	26.0	37.8	24.7	30.7
" Mean	4.33	6.30	4.12	5.12
Front	5.3	7.0	-	6.0
	5.2	7.5	4.5	6.5
	4.5	7.2	4.5	7.0
	5.5	6.5	4.5	4.5
	5.0	7.5	5.2	5.8
	4.0	6.0	5.0	5.0
Heft Total	29.5	41.7	28.7	34.8
" Mean	4.92	6.95	4.80	5.80
West Park	5.5	6.5	5.5	7.5
	5.5	6.2	5.5	6.5
	3.5	6.2	6.0	7.0
	4.5	6.3	4.8	6.0
	3.0	5.0	5.0	5.8
	4.8	7.0	5.0	5.5
Heft Total	26.8	37.2	31.8	38.3
" Mean	4.47	6.20	5.30	6.38
Tmt. Total	110.1	156.2	115.4	141.7
Tmt. Mean	4.59	6.51	4.81	5.90

APPENDIX TABLE 59(a)

The analysis of variance of the fleece weight (lb.) on June 16, 1954 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	95	113.20				
Between Total Tmts.	15	73.55				
Winterings	3	59.56	19.85	27.8 **	3.86	6.99
Hefts	3	7.57	2.52	3.53	3.86	6.99
Heft x Wintering	9	6.42	0.713	1.44	1.99	2.64
Within Tmts.	80	39.65	0.496			
Comparisons						
Winterings						
Away v. Away ½	1	4.38	4.38	6.14*	5.12	10.56
Away ½ v. Inbye	1	14.41	14.41	20.21	5.12	10.56
Inbye v. Hill	1	0.58	0.58	-	-	-
Hefts						
Howgate v. Rest	1	7.53	7.53	10.56**	5.12	10.56

** Significant at P<.01.
* Significant at P<.05.

APPENDIX TABLE 60

The fleece weight (lb.) in July 1955 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	5.5	7.5	-	5.0
	4.5	5.0	5.0	6.0
	7.5	5.5	-	3.5
	5.5	8.0	-	7.0
	5.5	6.5	5.5	5.5
	4.5	6.5	5.0	6.5
Howgate	6.0	2.5	3.5	3.5
	-	1.5	3.5	3.5
	1.5	2.5	3.5	3.5
	4.5	3.0	3.0	3.0
	4.0	4.0	2.5	3.5
	2.0	4.0	-	2.5
Front	5.5	-	-	-
	7.0	7.0	4.0	3.5
	5.0	6.0	6.5	6.0
	3.0	5.0	6.0	5.5
	4.0	6.5	-	5.0
	-	4.0	5.0	5.0
West Park	5.5	8.5	5.0	7.5
	6.0	5.0	5.5	5.5
	4.0	4.0	6.5	7.0
	5.0	7.0	4.5	5.5
	4.5	-	5.0	5.5
	5.0	5.5	5.0	4.0
Tmt. Total	105.5	115.0	84.5	113.0
Tmt. Mean	4.79	5.23	4.69	4.91
No. Observations	22	22	18	23

APPENDIX TABLE 60(a)

The analysis of variance of the fleece weight (lb.) in July 1955 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	84	187.40				
Between Winterings	3	3.33	1.11	-	2.72	4.04
Within Winterings	81	184.07	2.27			

APPENDIX TABLE 61

The fleece weight (lb.) in July 1956 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	-	-	5.0	3.5
	4.0	4.0	5.5	4.5
	5.5	4.5	-	-
	4.5	7.0	4.0	-
	4.5	6.0	-	4.5
	7.0	7.0	-	5.0
Howgate	5.0	4.5	4.5	4.5
	-	3.0	4.0	5.0
	3.0	4.0	3.5	4.0
	5.0	4.0	3.0	-
	3.0	5.5	3.0	3.5
	4.0	4.5	3.5	4.0
Front	5.0	4.0	-	4.0
	5.0	4.5	3.0	-
	-	6.0	-	4.5
	-	6.0	5.0	4.0
	-	6.0	3.5	5.5
	-	4.0	4.0	3.5
West Park	6.0	5.0	5.0	6.0
	5.0	3.0	6.0	6.5
	3.5	5.0	6.0	6.0
	5.5	5.0	5.0	5.0
	3.0	3.5	4.0	5.0
	3.5	6.0	5.0	3.5
Tmt. Total	82.0	112.0	82.5	92.0
Tmt. Mean	4.55	4.87	4.34	4.60
No. Observations	18	23	19	20

APPENDIX TABLE 61(a)

The analysis of variance of the fleece weight (lb.) in July 1956 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	79	85.35				
Between Winterings	3	2.96	0.99	-	2.74	4.08
Within Winterings	76	82.39	1.08			

APPENDIX TABLE 62

The fleece weight (lb.) in July 1957 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	3.0	4.5	6.0	-
	-	-	-	6.0
	7.0	6.0	5.0	5.5
	4.5	8.5	4.0	5.5
	5.5	6.5	6.0	6.0
	5.0	6.0	-	7.5
Howgate	6.0	-	-	3.5
	-	3.0	-	4.5
	3.5	5.0	6.0	4.5
	5.0	-	4.0	-
	4.0	5.0	4.0	5.0
	3.5	-	5.5	5.0
Front	6.0	6.5	-	5.0
	-	8.0	6.0	7.5
	-	5.5	-	-
	-	6.0	-	5.5
	-	5.5	-	7.5
	-	5.0	6.0	-
West Park	-	5.5	5.0	7.5
	5.5	3.0	-	6.0
	-	5.5	6.0	5.0
	6.5	4.5	-	5.5
	3.5	4.5	5.0	6.0
	-	5.0	6.0	4.0
Tmt. Total	68.5	109.0	74.5	112.5
Tmt. Mean	4.89	5.45	5.32	5.62
No. Observations	14	20	14	20

APPENDIX TABLE 62(a)

The analysis of variance of the fleece weight (lb.) in July 1957 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	67	94.42				
Between Winterings	3	4.64	1.55	1.107	2.75	4.10
Within Winterings	64	89.78	1.40			

APPENDIX TABLE 63

The fleece weight (lb.) in July 1958 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	-	5.0	7.5	-
	-	5.5	-	5.5
	5.0	6.0	-	5.5
	-	6.0	4.0	-
	-	7.0	4.0	5.0
	-	-	-	6.0
Howgate	5.0	-	5.0	-
	-	-	-	-
	-	5.0	5.0	4.5
	4.5	5.0	4.8	-
	3.0	5.0	4.5	-
	3.0	-	-	-
Front	5.5	-	-	4.0
	6.0	6.5	-	5.0
	-	5.5	-	5.0
	-	-	-	-
	-	5.5	-	-
	-	5.5	5.0	5.0
West Park	-	5.0	-	5.5
	-	-	5.5	5.5
	-	5.0	5.5	6.5
	4.0	6.5	5.0	4.0
	5.5	-	4.0	-
	5.0	5.0	-	3.5
Tmt. Total	46.5	89.0	59.8	70.5
Tmt. Mean	4.65	5.56	4.98	5.03
No. Observations	10	16	12	14

APPENDIX TABLE 63(a)

The analysis of variance of the fleece weight (lb.) in July 1953 of the ewe hoggs (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	51	40.44				
Between Winterings	3	5.70	1.90	2.04	2.80	4.22
Within Winterings	48	44.74	0.93			
Comparison:						
Away v. Hill	1	5.12	5.12	5.50*	4.04	7.19

* Significant at $P < .05$.

APPENDIX TABLE 64

The frequency and distribution of barren* ewes (1953 trial) expressed as a fraction of the number of possible annual observations

		Hill	Away	Inbye	Away ½	Heft Total
1955	Boghall	1/5	1/6	0/6	0/6	2/23
	Howgate	0/5	0/6	0/6	0/6	0/23
	Front	1/6	1/6	0/5	0/6	2/23
	West Park	1/6	0/6	0/6	0/6	1/24
Year Total		3/22	2/24	0/23	0/24	5/93
1956	Boghall	0/6	1/6	1/5	0/6	2/23
	Howgate	0/5	0/6	1/6	1/5	2/22
	Front	1/5	1/6	0/5	0/6	2/22
	West Park	1/6	0/6	1/6	0/6	2/24
Year Total		2/22	2/24	3/22	1/23	8/91
1957	Boghall	1/5	1/6	0/4	0/3	2/18
	Howgate	0/5	1/4	1/6	0/5	2/20
	Front	1/4	0/6	0/3	0/6	1/19
	West Park	0/5	1/6	0/5	1/6	2/22
Year Total		2/19	3/22	1/18	1/20	7/79
1958	Boghall	0/5	3/6	0/3	0/4	3/18
	Howgate	1/5	0/3	0/4	0/2	1/14
	Front	0/5	0/6	0/1	0/5	0/17
	West Park	0/4	1/5	0/5	0/5	1/19
Year Total		1/19	4/20	0/13	0/16	5/68
Lifetime Tmt. Total		8/82	11/90	4/76	2/83	25/331

* Barrenness taken to include abortions before full term development.

APPENDIX TABLE 64(a)

The analysis of variance of the annual percentage of barren ewes of the groups of ewes (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	15	530.53				
Winterings	3	256.37	85.46	3.20	3.86	6.99
Hefts	3	33.71	11.24			
Heft x Wintering	9	240.45	26.72			
Comparison:						
Wintering						
Away ½ v. Away	1	209.10	209.10	7.82*	5.12	10.56

* Significant at $P < .05$.

APPENDIX TABLE 65

The annual frequency and distribution of twin lambs (expressed as a fraction of the number of possible observations) born to the groups of ewes (1953 trial) having received four different hard wintering treatments

		Hill	Away	Inbye	Away ½	Heft Total
1955	Boghall	0/5	0/6	0/6	0/6	0/23
	Howgate	0/4	0/6	0/6	0/6	0/22
	Front	0/6	0/6	0/5	1/6	1/23
	West Park	1/6	0/6	0/6	1/6	2/24
Year Total		1/21	0/24	0/23	2/24	3/92
1956	Boghall	0/6	1/6	0/5	2/6	3/23
	Howgate	0/5	0/6	0/6	1/5	1/22
	Front	0/5	2/6	0/4	1/6	3/21
	West Park	0/6	0/6	0/6	0/6	0/24
Year Total		0/22	3/24	0/21	4/23	7/90
1957	Boghall	0/5	0/6	1/4	2/3	3/18
	Howgate	1/5	1/4	0/6	2/5	4/20
	Front	0/4	2/6	0/3	3/6	5/19
	West Park	2/5	3/6	1/5	0/6	6/22
Year Total		3/19	6/22	2/18	7/20	18/79
1958	Boghall	2/4	1/5	2/3	1/4	6/16
	Howgate	1/5	0/3	2/4	0/2	3/14
	Front	2/5	1/6	1/1	2/5	6/17
	West Park	3/4	1/5	1/5	2/5	7/19
Year Total		8/18	3/19	6/13	5/16	22/66
Lifetime Tmt. Total		12/80	12/89	8/75	18/83	50/327

APPENDIX TABLE 65(a)

The analysis of variance of the percentage of twin lambs born to the groups of ewes (1951 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	15	3,667.60				
Between Winterings	3	212.32	70.77	-		
Between Years	3	2,436.00	812.00	7.20**	3.86	6.99
Year x Wintering	9	1,015.30	112.80			

** Significant at $P < .01$.

APPENDIX TABLE 66

The adjusted* birth weight (lb.) of lambs born to the groups of ewes (1953 trial), in their first production year, 1955 having received four different home wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	7.6	8.5	-	6.1
	5.1	7.0	-	5.1
	7.0	9.1	10.1	7.5
	-	8.1	-	10.1
	8.1	-	8.1	8.5
	-	7.1	7.0	7.1
Howgate	-	11.1	7.6	8.1
	-	8.0	7.5	8.6
	8.0	8.1	9.6	8.6
	7.5	9.1	8.1	7.5
	8.6	6.5	8.5	8.0
	7.6	8.1	6.5	8.0
Front	8.1	8.6	-	8.2
	8.0	7.1	7.5	9.6
	7.6	-	-	9.6
	-	5.0	-	9.0
	-	8.6	5.0	8.6
	6.6	8.0	9.0	8.5
West Park	-	9.0	5.1	11.5
	8.0	9.1	8.5	9.5
	5.6	8.1	6.0	6.0
	8.5	7.1	8.6	8.7
	7.3	6.5	8.5	8.1
	6.6	6.5	9.0	7.6
Tmt. Total	125.8	174.3	140.2	198.1
Tmt. Mean	7.40	7.92	7.79	8.25
No. Observations	17	22	18	24

* Adjusted for birth type and sex.

APPENDIX TABLE 66(a)

The analysis of variance of the adjusted[a] birth weight (lb.) of lambs born to the groups of ewes (1953 trial), in their first production year, 1955 having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	80	134.30				
Between Winterings	3	7.70	2.57	1.57	2.72	4.04
Within Winterings	77	126.60	1.64			
Comparisons:						
Wintering						
Away ½ v. Hill	1	7.23	7.23	4.40*	3.96	6.96

[a] Adjusted for type of birth and sex.
* Significant at $P < .05$.

APPENDIX TABLE 67

The adjusted* birth weight (lb.) of lambs born to the groups of ewes (1953 trial), in their second production year, 1956 having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	10.6	11.5	9.1	8.6
	8.1	10.0	-	10.5
	10.0	8.9	8.6	9.4
	8.1	5.5	10.0	8.1
	8.1	-	10.6	7.5
	11.6	9.0	-	11.0
Howgate	6.0	13.1	11.6	6.0
	-	8.1	8.0	-
	8.6	7.5	9.0	6.6
	8.1	8.5	7.5	-
	12.6	5.5	9.1	7.1
	8.0	8.5	-	9.6
Front	6.6	9.2	-	11.5
	-	8.1	8.5	9.9
	10.0	-	-	7.1
	9.0	8.5	5.6	11.5
	8.5	6.1	7.6	6.1
	-	6.0	11.5	8.6
West Park	-	10.6	11.6	11.0
	8.0	10.0	8.5	10.1
	7.0	-	8.5	9.5
	8.6	8.5	8.6	5.1
	7.6	6.1	-	9.1
	9.5	9.6	9.5	10.5
Tmt. Total	174.6	178.8	163.4	194.4
Tmt. Mean	8.73	8.51	9.08	8.84
No. Observations	20	21	18	22

* Adjusted for birth type and sex.

APPENDIX TABLE 67(a)

The analysis of variance of the adjusted[a] birth weight (lb.) of lambs born to the groups of ewes (1953 trial) in their second production year, 1956, having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	80	248.59				
Between Winterings	3	3.17	1.06	-	2.72	4.04
Within Winterings	77	245.42	3.19			

[a] Adjusted for type of birth and sex.

APPENDIX TABLE 68

The adjusted* birth weight (lb.) of lambs born to the groups of ewes (1953 trial), in their third production year, 1957 having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	-	8.6	-	-
	8.5	11.0	9.0	9.0
	10.0	9.0	10.2	8.9
	12.0	9.0	9.6	-
	8.0	-	13.0	5.0
	-	11.0	-	-
Howgate	12.0	-	10.5	9.4
	-	11.5	8.6	7.0
	12.6	9.5	11.0	8.6
	12.0	-	9.0	-
	11.0	8.5	11.0	11.0
	10.4	8.3	-	10.0
Front	9.0	11.0	-	9.7
	-	10.0	8.6	12.9
	8.0	11.0	9.6	7.0
	7.0	7.0	-	8.5
	-	8.7	-	7.9
	-	8.8	11.0	10.0
West Park	-	9.9	9.0	12.0
	10.4	9.8	8.5	8.0
	12.0	9.0	7.9	-
	8.0	-	-	6.0
	10.4	9.0	9.5	9.0
	10.0	10.2	8.5	11.0
Tmt. Total	171.3	190.8	164.5	170.9
Tmt. Mean	10.08	9.54	9.68	8.99
No. Observations	17	20	17	19

[a] Adjusted for birth type and sex.

APPENDIX TABLE 68(a)

The analysis of variance of the adjusted[a] birth weight (lb.) of lambs born to the groups of ewes (1953 trial), in their third production year, 1957 having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	72	182.22				
Between Winterings	3	10.84	3.61	1.45	2.72	4.04
Within Winterings	69	171.38	2.48			
Comparison:						
Away ½ v. Hill	1	10.50	10.50	4.23*	3.98	7.01

[a] Adjusted for type of birth and sex.
* Significant at $P < .05$.

APPENDIX TABLE 69

The adjusted* birth weight (lb.) of lambs born to the groups of ewes (1953 trial), in their fourth production year, 1958 having received four different hoggg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	-	9.7	-	-
	10.0	-	-	8.7
	7.7	-	7.3	11.0
	8.2	7.8	7.7	-
	8.4	-	8.7	11.0
	-	-	-	10.3
Howgate	7.0	-	9.7	-
	-	-	-	-
	-	10.7	10.3	10.0
	11.0	11.0	8.7	-
	9.0	8.0	9.1	10.0
	9.6	-	-	-
Front	8.2	9.0	-	11.1
	10.5	7.5	6.7	12.7
	10.0	9.7	-	7.2
	11.7	5.0	-	-
	10.6	9.7	-	10.5
	-	11.1	-	9.0
West Park	11.5	11.6	-	8.7
	-	8.5	10.5	8.2
	-	-	9.5	10.3
	8.7	13.2	-	6.3
	8.1	-	9.3	-
	8.0	12.2	12.0	8.6
Tmt. Total	158.2	144.7	109.5	153.6
Tmt. Mean	9.31	9.65	9.12	9.60
No. Observations	17	15	12	16

[a] Adjusted for birth type and sex.

APPENDIX TABLE 69(a)

The analysis of variance of the adjusted[a] birth weight (lb.) of lambs born to the groups of ewes (1953 trial) in their fourth production year, 1958, having received four different hoggg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	59	160.10				
Between Winterings	3	2.55	0.85	-	2.78	4.16
Within Winterings	56	157.55	2.81			

[a] Adjusted for type of birth and sex.

APPENDIX TABLE 70

The adjusted* daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1953 trial), in their first production year, 1955 having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	.450	.485	-	.446
	-	.495	-	.563
	.330	.528	.505	.564
	-	.463	-	.533
	.467	-	.495	.352
	-	.471	.367	.499
Howgate	-	.453	.506	.554
	-	.513	.509	.547
	.461	.440	.454	.547
	.453	.537	.448	-
	.434	.495	.550	.530
	.450	.422	.555	-
Front	.472	.486	-	.377
	.431	.447	.428	.472
	.398	-	.398	.523
	-	.398	.432	.464
	-	.542	.483	.422
	.425	.559	.458	.408
West Park	-	.535	.388	.491
	.407	.490	.560	.487
	.412	.405	.514	.528
	.445	.481	.502	.434
	-	.583	.565	.368
	.535	.444	.407	.572
Tmt. Total	6.570	10.672	9.524	10.681
Tmt. Mean	.438	.485	.476	.485
No. Observations	15	22	20	22

* Adjusted for type of birth and sex.

APPENDIX TABLE 70(a)

The analysis of variance of the adjusted[a] daily live weight gain from birth to weaning of lambs from the groups of ewes (1953 trial), in their first production year, 1955 having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	78	.221646				
Between Winterings	3	.025145	.008382	3.20*	2.72	4.04
Within Winterings	75	.196501	.002620			
Comparison:						
Wintering						
Hill v. Rest	1	.02401	.02401	9.16**	3.96	6.96

[a] Adjusted for type of birth and sex.
* Significant at $P < .05$.
** Significant at $P < .01$.

APPENDIX TABLE 71

The adjusted* daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1953 trial), in their second production year, 1956 having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	.330	.519	.388	.459
	-	.450	-	.472
	.468	.446	.506	.479
	-	.484	.596	.481
	.562	.406	-	.515
	.536	.531	-	.438
Howgate	.523	.527	.460	.545
	-	.488	.409	.374
	.472	.423	.491	.488
	.478	.477	-	.573
	.493	.550	.464	.550
	.600	.452	-	.501
Front	.533	-	-	.577
	-	.484	.369	.545
	.398	.489	-	.449
	.495	.478	.357	.560
	.453	.506	.492	.505
	-	.513	.474	-
West Park	-	.539	.404	.476
	.437	.472	.557	.506
	.576	-	.473	.509
	.404	-	.486	.487
	.566	.597	-	-
	.421	.452	.474	.536
Tmt. Total	8.745	10.283	7.400	11.025
Tmt. Mean	.486	.490	.463	.501
No. Observations	18	21	16	22

* Adjusted for type of birth and sex.

APPENDIX TABLE 71(a)

The analysis of variance of the adjusted[a] daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1953 trial), in their second production year, 1956 having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	76	.254027				
Between Winterings	3	.014146	.004715	1.43	2.72	4.04
Within Winterings	73	.239881	.003286			

[a] Adjusted for type of birth and sex.

APPENDIX TABLE 72

The adjusted* daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1953 trial), in their third production year, 1957 having received four different hogg wintering treatments

	Hill	Away	Inbye	Away ½
Boghall	-	.559	-	-
	-	.618	.550	.613
	.520	.553	.527	.636
	.549	.557	.558	.555
	.566	-	.540	.598
	-	.570	.549	-
Howgate	.626	.437	.536	.597
	.558	.581	.536	.589
	.541	.647	.601	-
	.339	.548	.652	.613
	.616	.553	.636	.534
	.589	.594	-	.537
Front	.553	.559	-	.594
	-	.590	.508	.535
	.513	.487	.566	.644
	.607	.594	-	.527
	.626	.511	-	.631
	-	.523	.637	.621
West Park	.508	.598	.519	.584
	.483	.610	.587	.555
	.516	.649	.456	.565
	.457	.473	.530	.504
	.466	.520	.589	.492
	.576	.523	.500	.520
Tmt. Total	10.209	12.854	10.577	12.044
Tmt. Mean	.537	.559	.557	.573
No. Observations	19	23	19	21

* Adjusted for type of birth and sex.

APPENDIX TABLE 72(a)

The analysis of variance of the adjusted[a] daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1953 trial), in their third production year, 1957 having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	81	.250264				
Between Winterings	3	.013175	.004392	1.44	2.72	4.04
Within Winterings	78	.237089	.003040			

[a] Adjusted for type of birth and sex.

APPENDIX TABLE 73

The adjusted* daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1953 trial), in their fourth production year, 1958 having received four different hoggetting treatments

	Hill	Away	Inbye	Away ½
Boghall	.420	.545	-	.525
	.556	-	.571	.663
	.556	-	.435	-
	.426	.521	.542	.505
	.574	.550	.514	.510
	.537	-	-	.537
Howgate	.491	-	.573	-
	-	-	.613	-
	.514	.612	.495	.538
	.487	.592	.547	-
	.612	.616	.584	-
	.578	-	.421	-
Front	.454	.578	-	.521
	.421	.556	-	.450
	.460	.595	-	.521
	.575	-	-	.450
	.495	.573	-	.577
	.555	.530	-	.420
West Park	.537	.481	-	.602
	.542	.563	.529	.463
	.496	.495	.562	.511
	.552	-	.495	.574
	.523	.457	.554	-
	.480	.478	.569	.561
Tmt. Total	11.841	8.742	8.004	8.928
Tmt. Mean	.515	.546	.534	.525
No. Observations	23	16	15	17

* Adjusted for type of birth and sex.

APPENDIX TABLE 73(a)

The analysis of variance of the adjusted[a] daily live weight gain (lb.) from birth to weaning of lambs from the groups of ewes (1953 trial), in their fourth production year, 1958 having received four different hoggs wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	70	.209700				
Between Winterings	3	.009989	.00333	1.117	2.74	4.08
Within Winterings	67	.199711	.00298			

[a] Adjusted for type of birth and sex.

APPENDIX TABLE 74(a)

The analysis of variance of the annual mean growth rate of lambs from the groups of ewes (1953 trial) having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	$F_{.05}$	$F_{.01}$
Total	15	.022280				
Winterings	3	.001927	.000642	3.84	3.86	6.99
Years	3	.018827	.006276	37.58**	3.86	6.99
Year x Wintering	9	.001526	.000167			
Comparison:						
Winterings						
Away & Away ½ v. Hill & Inbye	1	.00156	.00156	9.23*	5.12	10.56

** Significant at $P < .01$.
* Significant at $P < .05$.

APPENDIX TABLE 75

The production years that the ewes (1953 trial) remained in the flock (as a fraction of the possible)

	Hill	Away	Inbye	Away ½
Boghall	2/4 4/4 4/4 4/4 4/4 3/4	4/4 4/4 4/4 4/4 4/4 4/4	2/2 3/4 4/4 4/4 4/4 1/4	2/2 4/4 4/4 4/4 2/2 4/4
Heft Total	21/24	24/24	18/22	20/20
Howgate	4/4 1/4 4/4 4/4 4/4 4/4	2/4 3/3 4/4 4/4 4/4 2/2	4/4 3/3 4/4 4/4 4/4 3/4	3/3 3/4 4/4 1/4 4/4 3/3
Heft Total	21/24	19/21	22/23	18/22
West Park	4/4 4/4 4/4 4/4 4/4 1/4	4/4 4/4 4/4 4/4 4/4 4/4	0/4 4/4 3/3 2/4 2/2 3/3	4/4 4/4 4/4 3/3 4/4 4/4
Heft Total	21/24	24/24	14/20	23/23
West Park	4/4 3/4 3/3 4/4 4/4 4/4	4/4 4/4 4/4 4/4 3/3 4/4	4/4 4/4 4/4 2/2 4/4 4/4	4/4 4/4 4/4 4/4 3/3 4/4
Heft Total	22/23	23/23	22/22	23/23
Tmt. Total	85/95	90/92	76/87	84/88

APPENDIX TABLE 75(a)

The analysis of variance of the percentage of production years the ewes (1953 trial) remained in the flock, having received four different hogg wintering treatments

Source	d.f.	s.s.	m.s.	F	F.05	F.01
Total	15	132.69				
Winterings	3	30.26	10.09	1.18	3.86	6.99
Hefts	3	25.60	8.53			
Heft x Wintering	9	76.83	8.54			